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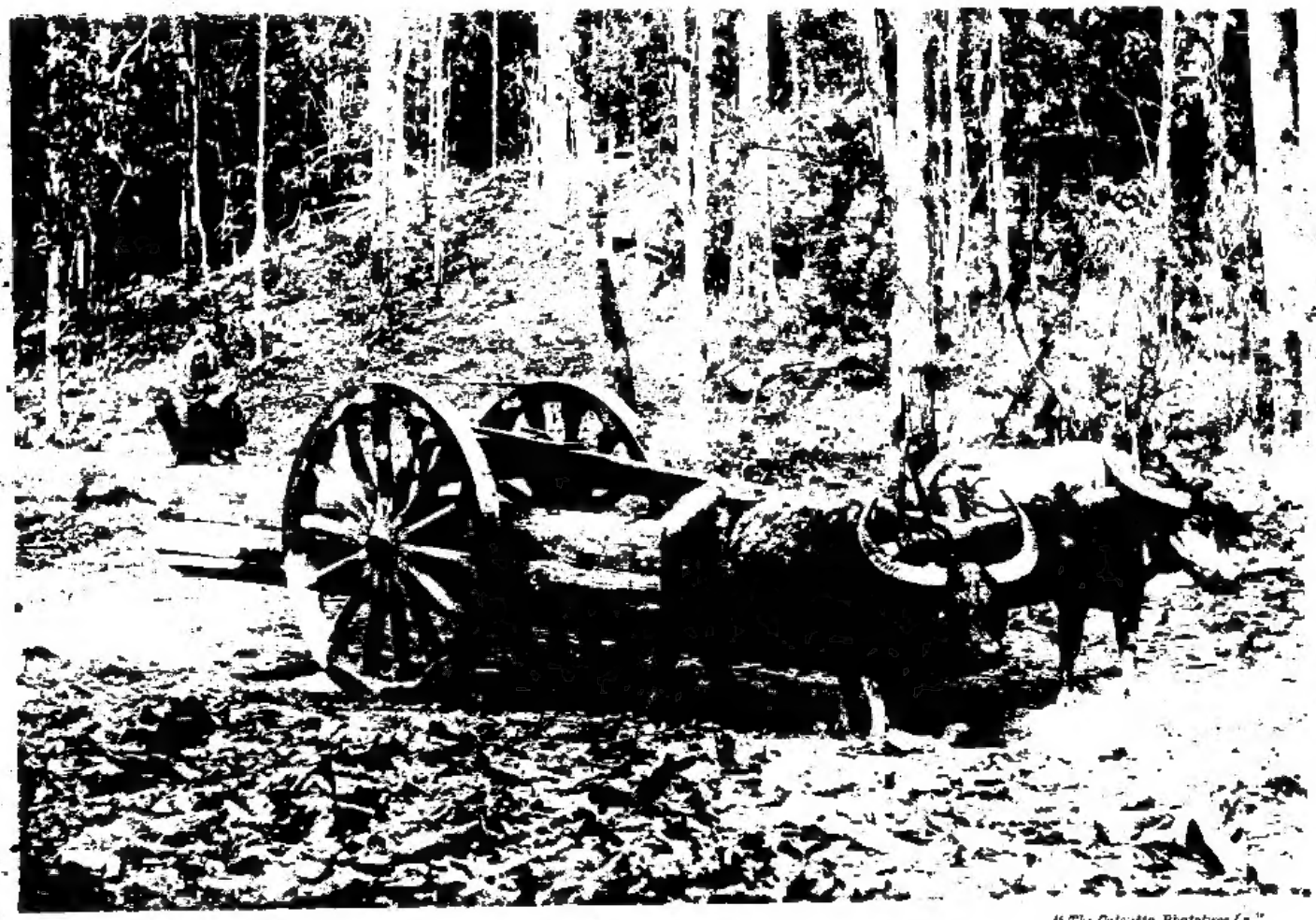
A Burmese Timber Cart.

The illustration, which serves as a frontispiece to Vol. XXI of the *Indian Forester* and which has been reduced from a negative taken by Mr. J. W. Oliver, Conservator of Forests, Upper Burma, by the Calcutta Phototype Company, shows one of the timber carts used for the transport of large teak logs in Upper Burma. It will carry logs up to to 30 feet long and even 8 ft. in girth. The axle of the cart is of iron, and is bent twice at right angles, so as to allow of a large log being transported with a comparatively small pair of wheels. The axle is square in section except where the naves of the wheels bear on it. The central portion of the axle is 18 inches above the portions on which the wheels rotate and is 3½ feet long. The wheels are 6 ft. in diameter, the nave being made of ironwood strengthened by four iron rings, each 4 inches wide. The spokes, 14 in number, are made of pyinkado and the felloes are of teak. An iron tyre six inches wide, and half an inch thick, is shrunk on to the wheel and is also fastened to it by screws.

The body of the cart consists of a block of pyinkado 8 ft. 4 in. long, 10 inches deep and 8 inches wide, and a groove rectangular in section is cut in its lower surface, so as to receive the central higher portion of the axle. The body of the cart is strengthened by the addition of two iron plates, one placed on either side of the block of wood and it is firmly bolted on to the axle.

The shaft which is 16 ft. long, 6 inches wide and 5 inches deep, is tenoned into the body of the cart and is further secured to it by two iron stays 20 inches long, 2 inches wide and ¼ in. thick. These stays are bolted through the iron plates on the body of the cart and also through the shaft. A strong iron bar ending in a hook is let into the upper side of the shaft so that the hook projects a little behind the body of the cart. This bar is 4 inches wide and 1½ inches thick, and including the hook, 46 inches long, the hook being 8 inches in length. The end of the bar is slightly turned up and is fixed to the shaft by means of an iron stirrup which passes over it, just in front of the turned up end.

The method by which the yoke is attached to the shaft is very ingenious and requires a little explanation. An iron stirrup 2½ ft. long, 2 inches wide and ½ an inch thick is bolted on to the free



From a Negative, by J. W. Oliver. *"The Calcutta Phototype Co."*

TIMBER CART USED IN THE FORESTS OF BURMA.

end of the shaft. Two iron loops, with an internal diameter of ¾ inch, are welded on to the stirrup, one (the plane of which is parallel to the direction of the length of the stirrup) is 3 inches from the end of the shaft and the other (whose plane is at right angles to the length of the stirrup) is 20 inches from the end of the shaft. The strong ring bolt which is fastened to the latter loop, and the rest furnished with two carved arms which works on it, stand out very distinctly against the side of the further buffalo.

An iron bar, 27 inches long, 3 inches wide, and ¾ of an inch thick, bent so as to receive the yoke, is fitted with an iron hook. The bend in which the yoke fits being quite close to the hook, a slot 5 inches long is cut in the bar at a distance of 3 inches from the other end.

The hook fits into the loop on the stirrup which is nearest to the end of the shaft, while the slot is passed over the ring bolt, and secured in position by the nut mentioned above. The top end of the hook in the illustration is in high light just above the end *of the shaft.*

The log is suspended from the iron by means of strong chains, the centre of gravity of the log being immediately below the hook from which it hangs, a chain is passed round the log near the front end and is fastened to the shaft, so as to prevent the log from swinging.

The cart is loaded in the following way. The cart is brought over the log so that the hook may be as nearly as possible above the centre of gravity of the latter. The free end of the shaft is then raised and the hook is thus lowered until it is just above the log. Chains are then passed round the log and fastened to the hook. The free end of the shaft is brought again to its proper position and the log is thus raised off the ground. The centre of gravity of the log is found experimentally in each case, and experienced cart-men can usually guage very approximately the place where the chain should be fastened and very little time is consequently required to attach the log to the cart.

C. G. R.

KALIANPUR,
November 29th, 1894.

Prologue to Vol 1, 1874.—(*Reprinted.*)

At the commencement of our undertaking, it behoves us to offer an explanation of the principles which will guide us, and the objects we shall have in view, if we are fortunate enough to gain the public approval, and be elected to represent forest literature in the estate of the Public Press of India.

Our object is to supply a medium for the intercommunication of ideas and the record of observations and experiments, as well as to catch all stray fragments of information, all *facts* and *data*, and to supply the place of "Notes and Queries" to the Forest Service generally.

As to our principles, they are decidedly liberal and independent. We, and all who communicate with us are free to express what we think; we shall not repress any criticism on what we honestly believe to be wrong, or say anything that we do not believe to be true, to please *any one*. We shall endeavour to extenuate nothing, and we shall "set down nought in malice."

But free, full and unfettered discussion of every principle and practice is the very life of forest science and forest art.

That discussion it will be our endeavour to facilitate with all the means at our disposal. But this thing we will do—we will impress on ourselves and our contributors the absolute maintenance of courtesy and good temper in the thick of the hottest discussion, and we will banish from our pages everything that verges on personality or harshness of expression. Our criticism will be directed to measures not men, to the opinion and utterances of the impersonal office, not to the thoughts and deeds of individuals.

We are suppliants at the the shrine of every temple of Government; we ask for assistance, for the speedy communication of every report and every paper that deals with anything of theoretical or practical interest in forestry, as well as of all orders that bear on the organization and interest of the Forest service, but we confidently expect that no authority will desire in return for such assistance, other than the gratitude which courtesy commands and a hearty endeavour on our part to support warmly, where support is due, without abandoning our right to criticize, where we cannot approve.

In pursuance of the general principles enumerated, we do not propose to open our columns to personal grievances; but questions affecting the organization of the service, or a section of the service, are legitimately within our scope. We propose to allow ourselves the option of declining papers which are unsuited for publication, or which are based on absolutely unscientific grounds; but we trust that the exercise of this discretion will rarely need to be called into action.

We have now earnestly to address our supporters in behalf of this new scheme of an Indian forest periodical. Above all we

want steady contributors. Now many forest officers feel, and naturally so, that they have no time for writing. Others feel that they have no facility with the pen, and perhaps too modestly imagine that they can do nothing to help. With regard to this feeling we would offer a few remarks. In the first place, while every number ought to contain a fair proportion of leisurely written and detailed matter, that share of the work must necessarily be handed over to those who have a gift for writing, and who have the necessary literary machinery, in the shape of books of reference, to assist them. But the only value of a periodical of this sort will not consist in its containing elaborate essays. A large proportion of it should be devoted to "scraps" and to brief "Notes and Queries." Every Forest Officer who is worthy the name keeps a note-book, and as some new fact or some new experience comes to his notice, or some "happy thought," tending to the facilitation of some portion of his work, flashes across his mind, he will make a rough note of it. There is actually no one who can go about from day to day on plantation work, up and down a river on timber transport business, demarcating a forest, making valuation surveys, or engage in any other branch of his ordinary business, but must see something and learn something, which is in itself valuable, and a distinct addition to the stock of facts which are the basis of all rational and practical progress in forest administration.

And here is *the* line for the forest officer who loves not desk and blotting paper. Send us in, then, rough and unartificial, from your note-book jottings. A diamond, even uncut, is a diamond still; and even if we cannot always have a diamond we can have a crystal, and that is a very good thing in its way.

We beg everyone to send what he has, and not to subject it to preliminary criticism, and put it on one side. "I did not think you would care about it; I thought it hardly worth sending," are sentences that consign to inutility many really valuable facts, many good suggestions, that may contain the germs, perhaps as yet only partially developed, of future progress, or of some important economy. Literary merit and excellence of style is not looked for in such communications.

Another way of helping may be indicated to those whose taste or the sterner call of duty, forbids literary work. Ask questions. The interchange of opinions and expressions on all sorts of forest matters will be most useful, and it will create a good discussion, which will be of vital importance to our paper.

We shall endeavour ourselves to keep a good look out for information gleaned from home literature, as well as that of other countries, but we would invite everyone to call our attention to articles and other sources of information of this kind, and to correspond with friends at home, with a view to keeping us informed of the progress of forest literature, furnishing us with notices of

recently published books, stating the price and class. Communications regarding the supply of forest material to public works, improvements to be made in transport, information regarding seasoning timber and impregnation, regarding buildings, hill roads, cheap bridges, and numerous other connected subjects, will doubtless enable the latter class to benefit the public with their experience.

So much is applicable to forest officers; but we hope that forest officers will not be our only contributors: the scope of subjects open to comment will no doubt enable district, settlement, railway and engineer officers to give occasional assistance. Procedure in settling forest rights, notices of forest tribes and their requirements, questions of organization, principles of settlement, etc., will furnish opportunities for the latter to help us.

We may add that we shall be happy to illustrate papers by diagrams and drawings of a simple character, capable of being reproduced in octavo size, by lithography or by simple wood cuttings.

As regards the authorship of papers, every contributor is expected to communicate his name, or with his initials, or under a *nom de plume*, or without any name at all. Either plan can be adopted, provided the real name and address of the writer be entrusted to the Editor.

Whenever possible, rejected MS. contributions will be returned to the author at his request.

The Magazine will be arranged under headings in the following manner.

I. Articles, translations, official papers communicated, etc.
II. Reviews.
III. Notes and Queries.
IV. Shikar and Travels.
V. Extracts from Official Gazettes, appointments, promotions, transfers, etc.

Circumstances may, of course, render a modification of this programme advisable or necessary.

It has been suggested that we should indicate the sort of subject on which papers, notes and queries, may be communicated. With a view, therefore, of giving information to meet such enquiries, and not by any means to fetter the discretion of intending contributors, we offer the following sketch.

In the first instance we mention the subject of organization of service and forest law. Then sylviculture, as artificial reproduction, methods of working the soil, of sowing and planting, the rearing and treatment of seedlings, description of tools, natural reproduction, methods of treatment, cultivation of minor forest produce, etc. Next come working-plans in all their bearings, as forest surveys, methods of ascertaining the contents of growing material,

and of the rate of growth, methods of working forests or plans of operations. Utilization of forests forms another great section, as the properties of the different kinds of wood, the harvesting of forest produce, marking, girdling and falling of timber and wood, tools, extraction of India rubber, production of lac, fruits, as of *Bassia latifolia*, grass, leaves, peat, etc. Then again charcoal burning, preservation of forest produce, especially of wood and seeds, impregnation of the former, transport of forest produce by land and water, dragging, carrying, carting, snow-sledges, timber-slides, floating and boating, and of all things road making. The different methods of the disposal of forest produce, sale of standing forest produce, working by Government agency, permits, private sale and public auction. Next we mention the protection of the forests and their produce against men and beasts, treatment and settlement of forest rights and privileges, area of forests, its maximum and minimum, forest boundaries and their demarcation, protection of *humus* and other beneficial substances. Protection of forests against fires, storms, avalanches, frost, and of forest trees against diseases. Forest statistics and forest finance are two more great chapters. Then the physical and chemical properties of the soil, their influence upon forest vegetation, the atmosphere and its importance, heat, frost, moisture, light, winds and storms. Effect of forests upon climate, inundations, landslips, etc.

The above subjects are those most intimately connected with forestry. But besides these there are many others to which our pages are open, as forest botany, geology, zoology, physical science and chemistry in their bearings upon forestry, national economy, agriculture, etc.

We shall further accept with thanks communications on camp life, travelling, sport, notes on forest tribes, their habits and customs.

These lists are far from exhaustive, but they are at least full enough to show that there will be very little difficulty in finding matter of interest to communicate.

The field is a wide one ; let us try and occupy it successfully.

(Sd.) W. SCHLICH.

(Sd.) B. H. BADEN-POWELL.

Extension of the trade in Padauk Wood.

Turning over the pages of the Continental Supplement to the 'Timber Trades Journal' our attention was caught by the advertisement "*Padauk* des Indes orientales. Bois fin des Iles

' d'Andaman et de la Birmanie, ressemblant au meilleur *acajou* ' propre pour meubles de tous genres, plaques, construction de ' batiments et de navires, voitures de chemin-de-fer etc. etc." on sale by Messrs. Ogilvy, Gillanders & Co. at 67 Cornhill, London, and Messrs C. Leary & Co. 108 Bishopsgate St. Within.

That padauk wood has succeeded in establishing itself in the home market as a valuable wood is now an accomplished fact, and our enquiries have led us to ascertain that the uses of padauk are really much more varied and its value much more widely appreciated than is generally known in India to be the case.

In India, ' padauk ' has long been used as a gun-carriage wood and we used to see, some fifteen or more years ago at the Kidderpore Dockyard and Hastings Arsenal in Calcutta, great blocks of the wood stored for seasoning for Ordnance purposes—while an exhibit of a ' padauk ' gun-carriage at the Indian and Colonial Exhibition of 1886 might have shewn the home military and naval authorities what a valuable wood we had in India for the purpose. In 1877, when the Government of India started workshops in Calcutta and after obtaining wood specimens of authentic determination from nearly all provinces, prepared a magnificent collection for the Paris Exhibition of 1878 with smaller sets for various Indian, European and American Institutions, a huge log of padauk was one of the receipts from the Andamans. Out of its centre was cut a plank nearly 4 feet in diameter which went to Paris and is now, we presume, either at Nancy or at Kew. The rest of the log, after smaller specimens had been made out of it, was sent to England for sale with other woods and fetched a price of £17-10s. per ton, or nearly Rs. 4 per cubic foot, nearly double what is now received. But then we suppose that the exceptional beauty of the figure of the pieces of 1878 led to a fancy price being given for them. At the Paris Exhibition in that year (see ' Manual of Indian Timbers') some furniture made of padauk was exhibited by Messrs. Jackson and Graham and this was probably the first appearance of padouk wood in a commercial light before the European public. The wood was much admired and was most favourably reported on for appearance, durability and capability of standing climatic changes, and since that time its use, and, of course, the trade in it, have largely developed.

In India it is almost less known than it is at home ; the price which padauk wood has lately fetched in Calcutta being very little over Rs. 1 per cubic foot. That obtained in Madras is much better and reaches Rs. 1-8 showing the greater appreciation of its merits in the Southern Presidency. As a practical example of the value of ' padauk ' as a wood for interior decoration we may instance the ball room of one of the chief houses at Simla which was laid down by a recent owner a few years ago in padauk wood, with results which have left nothing to be desired in point either of beauty of appearance or of suitability for dancing. The floor

has stood as well, if not better, than teak wood would have done. In the same way, the use of padauk wood is extending on the Continent of Europe for the construction and laying down of 'parquet' floors, a purpose for which we can scarcely imagine any wood to be better adapted.

In the Handbooks issued under the name of the 'Imperial Institute' series, an account was given in 1892 by Mr. E. Thurston, then Reporter on Economic Products to the Government of India, of the gradual introduction of padouk wood into use and of its gradually increased exploitation in the Andamans. It was pointed out that the permanent introduction of the wood into the London market might be said to date from the time of the Indo-Colonial Exhibition. The Handbook gives an account of the use of the wood by Messrs. Coles & Co., of Coleman St., in building a hand-rail and a dado to the side of a stone staircase at 45, Fenchurch Street, and it is stated that for both purposes the wood came out of very fine figure and of excellent tone and colour. Padauk is also said to have been used by Mr. Joseph Roberts of Bigg Market, Newcastle, in fitting up a new Pharmacy in that city. The effect produced by the use of polished padauk for windows, doors and casings is said to have been unique and to recall the finest examples of Spanish Mahogany. Another London firm has lately employed it for the fittings of a telephone room.

Lately, it was suggested by the Government of India that some of the panelling and furniture of the Imperial Institute might with advantage be made of padauk and this has now been done, with, we are given to understand, excellent results. It has been tried and is, we hear, now extensively used by makers of pianofortes; and cases made of it ought to look remarkably well.

Lastly, among instances of the spread of the use of padauk timber, we may refer to its employment in America in the building of Pullman cars for which it has been most successful. We hope that this may induce the very conservative builders of railway carriages in this country to employ it to some extent, instead of teak, for their purposes, and, if we are correctly informed, there is one reason which ought forcibly to appeal to the travelling public and that is that in case of accidents, padauk breaks clean and does not, like so may other woods, go into splinters likely to inflict dangerous wounds.

We think we have now said enough to draw attention to the padauk trade and to encourage Forest Officers and others to recommend its more wide employment. There are many other woods in India which deserve better commercial popularity, but they cannot all hope at once to command the market; we ought to be well satisfied if one by one they can be introduced and utilized for furniture, sleepers, flooring, pavement blocks or what not, to the advantage of the revenue of the Indian forests.

The Forest of the Barwani State, Central India.

We have received a copy of a report on these forest by Mr. R. Fagan, Deputy Conservator in Bombay, written in 1891, and we believe that the following extracts will prove interesting to our readers.

The Barwani State I understand to be the entire property of the Rana Sahib, but under the management of the Central India Agency, and therefore forest conservancy, if introduced, can be maintained in perpetuity and according to the general lines laid down for British India.

The State covers an area of 1,755 square miles and has a population of 79,897 according to the figures of the census made this year The State is bounded on the north by the Nerbadda river, on the east by Holkar's territory, and on the south and west by the Khandesh Districts of the Bombay Presidency. It is of a fairly compact quadrilateral shape comprising a slice of the Satpura range, which runs diagonally across it from south-west, there being two plains left, one in the north-east and another in the south-western corner of the State. The Satpura Hills are, however, again divided into two main ranges by the Goi river which practically runs in the same diagonal direction

as the hills themselves. The "Thalweg" of this river forms a long but irregular plain between the two main ranges. The highest point of the northern range, 2,111 feet above sea-level, is only 5 miles from the Nerbadda river, the bed of which is itself about 850 feet above sea-level. The highest point of the southern range is 3,322 feet above sea-level, its southern slopes rising abruptly from the Tapti valley, which at their base has an altitude of 800 to 900 feet, whilst on the northern side, though the general gradient is less, the country is one extended mass of forest-clad hills with peaks of great height, especially on the western side.

Viewed from any of the more important peaks, a most picturesque country of mountains is seen, apparently uninhabited and covered with dense forests, extending for miles downwards until the main tributaries of the Nerbadda and Tapti are reached, where the alternating black and white patches denote the presence of man. These hills covering more than ⅔rds of the entire area of the State, must therefore play a most important rôle in connection with the water systems that flow into the Nerbadda and Tapti rivers. It results from this that the location of forest generally must be confined to the two ranges, whilst agriculture must be allowed full scope in the three main valleys.

The State for administrative purposes is divided into six parganas; the following table shows the area of each, its population and cultivated acreage:—

	Area, acres.	People.	Lands occupied, acres.	Lands unoccupied, acres.
Barwani	91,689	12,853	57,306	34,383
Rajpur	106,781	17,699	19,872	86,909
Anjar	108,800	16,971	32,759	176,041
Jalgone or Pansemal ...	424,914	13,772	62,500	362,414
Pati	328,791	7,161	17,675	310,016
Silawad	48,654	11,441	36,250	12,404
TOTAL ...	1,109,629	79,897	226,362	983,267

These figures must, as far as computed area of occupied and unoccupied lands are concerned, be very far from correct, especially in the Rajpur, Anjar, and Jalgone parganas, and it will be really found that nothing approaching this amount or proportion even (should both occupied and unoccupied areas be incorrect) of unoccupied land exists, and at any rate I know that the forest area cannot be raised above 50 per cent. of this waste area. The revenue proceeding from 226,362 acres is stated to be Rs. 85,932-4-3 or an average assessment of 6 annas only. The forest lands as at present existing are the unoccupied areas, and they produced last year, 1889-90, Rs. 11,800-4. The whole revenue of the State being Rs. 1,98,870-14-1.

I take it that the oldest standing cultivation is that immediately south of the Nerbadda, then that in the Goi valley, and lastly that of the Tapti. In the first valley agriculture has reached the extreme limit of its extension as far as clearing the land of trees is concerned; there is much land, however, waste in the plains which it is not necessary to include in forests. The cultivation is generally of a high order throughout. In the Goi valley, I consider, in spite of the figures given above, that cultivation has not only reached the extreme limit that sound sense and good government should permit, but has passed it, for shifting cultivation of the most disastrous and profitless description is now being daily carried higher and higher up steep slopes overhanging narrow and fertile fields which lie along every main tributary, and in which the only good cultivation is possible for this country. The results are shewing themselves, and in a few years barren slopes and infertile fields in the valleys will be the residuum. In the Tapti valley there are still vast tracts of virgin soil suitable for the highest order of agriculture, and it is very clear that every acre of the flat land south of the Satpura slopes should be retained for cultivation, but that on the other hand the slopes should be conserved if only to protect the land of the valleys. For cultivation on them will only lead to the destruction of valuable timber forests and the reaping of a miserable crop of inferior cereals for a few years, after which the land will be thrown up. It is clear from the topographical maps, that in 1877-78 nearly the whole plain of Jalgone or Pansema. was one immense forest. At present it is nearly all cultivated, on the average, up to within a mile of the lowest slopes, and within this narrow land I have myself seen that hundreds of acres of forest are now yearly going down before the axe of the Powras of the Akrani.

The forest administration of the State has evidently been for some time past a very serious point of consideration to the State, and though I cannot congratulate the State on the results of its endeavours so far, still there is no doubt that the fact is

well known to the people that the forests are State property in which, owing to the peculiar circumstances of the case, they are exercising a freedom to which they have not the shadow of a right. The forests at no very late date extended over the whole of the Silawad, Pati and Jalgone parganas, and the higher parts of the Rajpore, Barwani and Anjar parganas. They are now, owing to the sense of security inculcated into the cultivator, almost entirely confined to the hilly tracts of these parganas, and they are most heavily cut into, not for the local wants of the agriculturists but for the purpose of enriching the wilder tribes who inhabit them, and who have not in the past had cause or reason to live by the means now absolutely forced upon them by the demands of advancing civilisation. This is the point on which the whole forest administration of the future must hinge.

We have had in the past, forest conservancy of the first order in which nature gave the most perfect forests; then within the memory of its present inhabitants, the wild tribes of the hills were shown they could no longer live by dakaiti and theft; cultivators they were not, but by degrees they have become so. Many tribes, notably the Powra and Bhilala, shew great aptitude as cultivators, whilst others, such as the Bhil Naiks, are more backward or prefer not to leave their hills. In the race of agriculturists the latter are left behind, and now demand wood of these forests to eke out the miserable sustenance their indolent and unpractical labour in the field affords. Time will and must alter all this or the forests must go.

The State on seeing its forests cut down, naturally insisted on its claims of royalty, with what result is clear from the revenues obtained. From 1870 to 1875 Rs. 13,000, including grazing and grass, was about the average revenue; it fell in the next five years to Rs. 18,000 about. A small expenditure was then incurred on forest establishments and a road made through the best forests of the State, which must previously have been inaccessible; the revenues then for the next five years rose to Rs. 18,000 but the forests getting played out, the last five years shew they have dropped, with increased expenditure, to about Rs. 12,900. A decreasing revenue shows that something is evidently going wrong with the forests themselves, which should of course be a regular, if not an increasing, source of income, especially when a Forest Department has been introduced. At the present day the Department consists of one Daroga, one Naib Daroga, six Duffadars, eighteen Forest Guards and one Clerk, costing Rs. 2,516 per annum. The Daroga at the head gets Rs. 30 per month and the lowest paid Forest Guard Rs. 5 The whole expenditure of the Forest Department is now Rs. 2,690 only.

The Daroga issues orders to the subordinates as received from the Diwan of the State. The orders, as far as I have been

able to get information on the point, are of a general and decidedly indefinite nature on all points relating to conservancy, but are sufficiently clear as to what money may be levied on forest products taken out of the forests, as may be seen from the list of fees now charged on various products. Nearly all these fees are levied at the custom houses of the State. The Forest Department have apparently no control whatever over the removal of any of these products, the permit being given in the first instance for the more valuable timbers by the Kamasdar of the Pargana. It is said that it is the duty of the forest officials to point out to the Bhils and others (who want the materials) the places in open forests from which to remove them. Nothing could be better than this system, but I am afraid the forests tell a very different tale than of the accurate working of this system, which moreover is quite impracticable with so few forest guards. A most ingenious, and, if enforced, a most certain, method of minimising the harm done by the permit system is that of allowing timber only to be cut for one month annually by the Bhils for sale from the open forests. But again here the limits of open and closed forests are matters left entirely to the appreciation of the cutter, and of what avail are all the orders if at any time any man may for his own use cut any tree or remove any product he likes; there is no system regulating the correspondence of, and reports on, forests by the forest officials; there is no system of accounts to check fraud and to ensure the greatest possible revenue being received by the State. These matters are left to the energy and honesty of an extremely weak and underpaid establishment.

The points then that strike me the most forcibly as needing immediate attention are—

1st.—The demarcating of the forests from other State lands by pillars and other boundray marks.

2nd. The separation by well-defined boundaries of the closed and open forests.

3rd.—The separation in the matters of privileges to remove forest produce of the inhabitants of forest villages from inhabitants not residing in forests.

4th.—The separation in the matter of extended privileges of the aboriginal from the other inhabitants of forest villages.

5th.—The curtailment of the permit system to products of secondary value.

6th.—The exploitation of the more valuable products under direct State or departmental supervision controlled by an annual working plan.

7th.—An increase to the forest establishment and improvement in the status of the chief forest officer.

8th.—A separate system of accounts to be kept by all officials collecting and disbursing money on account of forests, the said accounts to be under the control of the chief forest officer.

9th.—A proper system of reports, general, monthly, quarterly and annual, to be submitted to ensure the working of each individual officer at his post and the carrying out of all the works laid down to be done during the year.

Demarcation of the Forests. From my personal observations whilst on tour I have been able to make a prospective boundary line (see map accompanying) for the forest; it is merely the basis upon which the actual boundary must hereafter be made. Within its limits I included roughly in the northern range 100 square miles in the southern range 450 square miles or 550 square miles; in all these I have left a good deal of waste outside of forests. This was inevitable, as land fit for cultivation is not yet taken up everywhere, much is fallow and any infertile tracts are so isolated, small or otherwise unsuitably constituted for forests, that they could not be included in my scheme.

I shall treat along with the *Northern range* the half-dozen detached hills lying between it and the Nerbadda. The main range as stated above runs diagonally from Rajgarh on the Goi river south-east to Raika pass in the Rajpore Pargana, a distance of 28 miles length, extending from Bawangaz towards Pati and one or two minor spurs in Rajpore and Anjar Parganas. With these exceptions the block is extremely compact and evades all present cultivation except some small plots of a miserably poor description in impossible places on the hills which should in time be taken up; of course no interference is proposed with the lands connected with the Jain temples of Bawangaz.

The range is, like the rest of the Barwani State, composed of basalt, and consequently the forests are typical of that formation; it is, however, especially the home of that extremely valuable, delicate and rare timber tree the Anjan (*Hardwickia binata*). On both the northern and southern slopes this tree is, owing to its numbers and size of growth, the chief among the valuable species. Then come in orders of quantity among the better kinds (see appendix for technical names, etc.) Dhanda, Sadada, Khair, Tinas, Teak and Blackwood, all more or less destroyed as far as sound trees of any size go, but they are by the nature of things the main species and could become both numerous and sound. Associated with them in small quantities, chiefly in the ravines, will be found amongst the better species, Bor Kalam, Behda, Mango, Mono. Jambul, Tamarind, etc. The forests are at present, I regret to say, comprised, for more than ¾ths of their vegetation, of the inferior species, Salai, Mohni, Kad, Ganur, etc.; there are also a few bamboos in the more westerly portions of the range. Babul,

strange to say, I saw nowhere except near Barwani town ; sandal-wood is quite unknown. The forests within my boundary are on the whole on the southern slopes than on the northern, but all are perfectly capable of restitution if taken in time. These forests are moreover better in the west than east.

The *southern range* needs for description of its demarcation and constitution to be divided into two parts: a first comprising the northern side, which slopes to the Nerbadda, and a second comprising the southern which drains into the Tapti valley. The demarcating line between forest and cultivation fixed by me on the northern slopes, leaves out of forest a very great deal of the hilly lands and excludes the ravines of the bed of the Goi, Jarkal and other rivers, almost up to the sources of their various tributaries on the main ridges and hills. There is now no help for this. These lower hills are all more or less cleared of trees, or so enveloped in cultivation that to bring them under conservancy would entail much friction with the cultivators. I admit that wholesale destruction has taken place below my line, is taking place in parts above it, and will extend rapidly unless a boundary line is quickly put down. The cause is shifting cultivation which should be discouraged as much as is possible, for after the destruction of a valuable lot of timber, poor crops are taken from the land for two years, may be three, and then the land deserted and a fresh hill attacked further in. To this there must be a limit placed if only to protect the cultivation in the ravines which is practically the only permanent and rational cultivation on this side of the Goi river. It will be seen from the map that on this side there is practically no plain or level country, and that the hills really extend down to the banks of the Goi itself. In places such as Roesar, Zarar, Marwani, etc., what are known in Khandesh as Bhil or forest settlements, that is habitations and fields entirely surrounded by forest, will have to be demarcated. There is no disadvantage in a few such plots of lands being inside an extended tract of forest ; on the contrary they facilitate protection by enabling posts or head-quarters of forests officials to be located in them. If the people were not there the forest officials would not live there alone, and no help would be within miles for purposes of fire conservancy, arresting offenders, etc. In fact without these habitations, there would be no means of either protecting or working the forests. It is of course different where the forests are in a narrow strip, two or three miles broad.

The forests of this tract in the greater part are of the very best kind, but have been most shamefully treated as far as the better species are concerned even up to the highest points ; in fact it is the one characteristic of the Barwani forests that the best species have been always the most maltreated, whilst inferior species except in the vicinity of cultivated lands have been allowed to flourish.

The timber species contained in these forests are Anjan, Teak, Sadada, Tinas, Sissam, Khair, Kalam, Dhawda, Temru, Bherda, Shivan, Chinchola, Daman, Jambu, Moka, etc. The first half-dozen are the only ones cut for the market at present, and from them apparently no one troubles to take anything but the best part of the tree or the biggest beam In consequence it would be difficult to point out one tree in ten that is sound, whilst the stumps and branches of the hacked and felled trees strew the forests throughout in various stages of decomposition owing to the action of fire, air and water. The Anjan is essentially the tree of the lower ranges, teak that of the higher. I have seen the finest specimens of Anjan, Teak, Blackwood and Tinas as well as of other species here that I have ever seen anywhere. The size to which teak grows is enormous, 10 and 12 feet in circumference, but under present treatment it is made unsound at an early age. A blackwood on "Deoghar" measured 9 feet in circumference. If trees grow sound they grow larger and to a geater age than unsound. The minor species of this range are numerous but I would specially note among valuable fruit trees the Moho, Charoli and Mango which abound here. The bamboo is found in great quantities and of very good quality in the middle and upper ranges. The value of this species, seeing the easy means of transport through this wild country, ought to be very great to the State. I am told that the "Gol Pahar" forests, south of Sustikhera in the Silawad Pargana and north of Sidili, are the best in this tract, and contain the finest Teak, Blackwood and Tinas; they must be very good to beat anything near Ramgarh, Deogarh, Ubadagar and other places, I am confident that they have been just as shamefully cut about as the other so-called closed parts. "Gol Pahar" is the only tract I failed to examine, owing to the orders regarding my extension coming after I had left the Barwani.

The forests from end to end inside the proposed demarcation line are one and all capable of producing the best trees that can be grown on this side of India. The land is essentially unfit for agriculture owing to the rapid slopes on which only a shallow soil held together by the roots of trees is possible, as the substratum is a deeply fissured rock which permits of roots of trees alone being able to obtain moisture from the great depths at which it is found. This fact will also account for the paucity of water springs in this area which of course in turn precludes any great increase to the number of inhabitants or cattle. The State may therefore without any apprehension for the agricultural classes put under forest 300 square miles (192,000 acres) about, as proposed by me for the north side of the range.

I now come to the south side. The demarcation proposed here is very simple; it follows the bare contour line of the hills extending from east to west of the Jalgone or Pansemal Pargana; it will, I think, be found to contain roughly 150 square miles (96,000

acres), and has practically no cultivation inside. In fact the cultivator is as yet occupied in clearing the rich plains below the hills where he has many square miles of forest yet to cut down, but he must be prevented from mounting the slopes which are covered with teak forest of the very first order. Anjan is not found here (I only saw three trees), but other species mentioned above grow to large and valuable sizes. There ought to be an enormous revenue made from these forests, seeing that they are all within easy carting distance of the Khandesh timber markets and its ginning factories.

The care and management of Farm-manure in South India.

The manure obtained from his cattle is almost everywhere the chief standby of the farmer for manuring his land.

It is only by manuring his land well and tilling it properly that the farmer can hope to secure good crops from it; and how greatly his success in this respect depends upon manure is a matter of common experience. With sufficient manure and abundance of water, there is scarcely any limit to the productiveness of the land in India. Manure and water are in this respect inter-dependent; the supply of water being that obtained in the falling rain or from irrigation works or wells. The matter at present so to be considered is, however, the manure supply.

Unfortunately the amount of manure which the ryot finds at his disposal is usually but small. It is often also of but poor quality. Owing to want of proper care of the supplies available and to bad management, the stores of manure are generally small. Similar reasons explain the low quality of the manure.

In some places where wood fuel is scarce and near large towns a very large proportion of the cattle dung is made into cakes and used for fuel; only a little ashes remaining for use as manure and even these, in cases where the cakes are sold into towns, are lost to the ryot. When his cattle-dung is burnt by the ryot himself, the ashes are generally thrown into a heap in the open, where they become leached of much of their valuable matters. That the practice of burning cattle dung is a cause of great loss, is known to every one. By using the dung of his cattle for fuel, the ryot makes only a very petty saving in expenditure, whilst he could, by growing fences round his fields, as is done in parts of Coimbatore and Salem, or by setting apart a small portion of his fields on which to grow trees for fuel, easily provide himself with fuel sufficient for his wants. By such means the very wasteful practice of burning cattle dung may be avoided. Near large towns, the price of fuel is so high as to render the growth of fuel trees generally a profitable undertaking.

The more general practice of the ryot is, however, to accumulate the dung of his cattle in a loose heap in the open air. The dung there dries into hard lumps, and is thoroughly washed by any rain that falls. It suffers loss in every possible way; and the ultimate result is a small heap of very poor, almost valueless, stuff left to be carted to the fields. With the dung is to be seen a certain amount of straw and leaves. Each material is left to itself, the dung to lose its value, the stalks to become hard and desiccated. Because in India no litter is supplied to the cattle, not once in a thousand times is any attempt made to save the urine of the cattle when they are kept in the houses or sheds of their owners. Wasteful this process is, because the solid manure is exposed as described. Still more wasteful and injurious is it, because the liquid manure is not only not preserved, but is allowed to sink into the ground, and especially into the hollows made by the feet of the cattle, The soil on which the cattle stand is saturated below by the urine. and the air of the house or shed becomes foul and contaminated. Every one has noticed the strong and peculiar odour found in these sheds in the morning This is due mainly to the evaporation of valuable matters contained in the urine which drops on the floor and is lost.

The value of the urine of his cattle as manure is not, it is to be feared, appreciated fully by the ryot, even if the value thereof is not totally unknown. The urine, as a matter of fact, is richer in fertilising matters than the solid excreta of cattle, and the loss involved in letting the urine go to waste is very large. This loss may be avoided by the use of litter to absorb the urine, or even by sprinkling the floors of the cattle-sheds with dry earth, if litter be unprocurable. By the latter process, much of the urine could be saved; the earth being allowed to accumulate in the sheds till required for use as manure, or being removed as soon as it becomes saturated and carefully preserved in a manure pit as is described below. In cases where cattle are tethered or penned in the fields, the urine soaking into the land is not lost.

If the ryot be asked why he does not use litter for his stock, he usually says that he has not enough fodder to feed them properly, still less has he straw for use as litter. The appearance of so much waste straw, &c. in the manure heaps is, however, often evidence that this is not the reason, for these matters, as well as coarse grass, weeds, leaves, and rubbish of all sorts might be used as litter, and the quantity required, especially if dry earth be also sprinkled over the floors, is not large.

As has already been said, the most valuable portion of farm manure consists of the urine of the cattle. The manure comprises also, when properly made, the whole of the solid dung as well as litter used for bedding the cattle. As it consists of litter and the voiding of animals fed on the produce of the soil, it forms in itself a complete fertiliser. In the making of good manure, it is of importance that all these matters should be thoroughly and

intimately mixed and that they should be preserved carefully after they have been collected ; so that the whole mass may ferment and decompose slowly and thoroughly. The value of farm-manure lies probably as much in the mechanical effect it has on the soil to which it is applied, as on the fertilising matters it contains. The mechanical effect depends greatly, if not chiefly, on the state of decomposition in which the manure is when applied to the land.

An excellent method of managing farm-manure suited to the conditions of the ryot is described below. In this method the dung and the urine are not removed from the shed except at intervals of several months, when the manure is required. The litter used absorbs the urine.

The floor of the cattle-shed should be made 2 or 3 feet lower than the surrounding ground, and the sides and the bottom of the pit plastered with clay. On the floor a layer of ashes should then be spread once for all, and every day a layer of vegetable rubbish should be spread over the surface as litter, that is, for bedding. For this purpose, leaves, coarse grass and other vegetable rubbish may be collected and stored during those parts of the year when they can be easily procured and when the ryot and his cattle have plenty of leisure. Waste fodder and various refuse portions of crops, such as the ear-heads from which corn has been thrashed &c., may be used as bedding. The shed may be 10 feet long and 6 feet broad for a pair of cattle. It is best the cattle should be left loose in the shed, so that they may tread on every part of the manure and press it down. If the manure is not pressed, it will rot too fast and become much heated and give off bad smells and the health of the cattle will be injured. Every morning the dung dropped by the cattle in the previous night should be evenly distributed and a thin layer of litter spread over it. In this manner the manure may be collected until the pit is filled, which may take about three months.

Too much bedding should not be supplied ; otherwise the manure will be too dry and not decompose with sufficient slowness and thus lose in value. The manure in the pit should always be thoroughly moist throughout its bulk. If the manure has an ash-colored appearance anywhere when it is being removed that is because it has not decayed properly ; the appearance being due to the great heat caused by the manure being too dry. If the straw, &c., supplied as bedding be long and hard, the manure will not rot properly ; such litter should be cut up into short pieces. Unless the manure is well rotted, it will not be of much use to crops, as it will not act quickly. It will also make the soil too open, so that the crops thereon may suffer much from draught. The manure, if properly managed, will be of a black colour and of mellow substance, thoroughly rotted throughout so that it may almost be cut with a knife. In removing manure from the pit the unrotted portion near the surface should be placed on one side, and after the well-rotted

portion has been taken out, should be put back again at the bottom of the pit, and manure may be collected again as before.

By this method of managing manure, about 5 to 7 tons of good manure may be obtained yearly for each head of cattle kept, whereas if the dung be thrown out in loose heaps in the open air, only about half a ton of very inferior manure will be obtained in the year. The only objections raised the system are :—

(1) That it is supposed to cause unhealthiness amongst the cattle housed.

(2) That it requires a large amount of litter to be supplied.

In reference to the last, it may he noted that in some parts of South Canara the ryots take great pains to collect leaves and grass, and supply bedding to their cattle ; but they remove the manure at intervals of a few days, and throw it out in a hollow place where it can be compressed by the carts travelling to and fro over it. In reference to the first objection, experience has shown that it is groundless.

If for any reason, it is inconvenient to a ryot to collect manure in the above-mentioned manner, the following method may be adopted :—

The floor of the cattle-shed should be made smooth and compact with a gentle slope towards the back, where a small channel should be placed so that all the urine falling on the floor may be carried by the channel to a pot placed outside the shed at one end. The dung can be removed every day and thrown into a pit, the sides and bottom of which should be plastered with clay, and over which a low thatched roof should be erected. Whatever vegetable refuse is available on the farm may be thrown into the pit, and the urine collected poured over the heap daily. The whole mass of dung, urine and vegetable rubbish should be kept uniformly mixed and well trodden and pressed down so as to make the mass decay uniformly and slowly.

If the manure pit last described cannot be protected by a simple shed, the heap should be covered with earth. It has in all cases been found very useful to cover manure heaps with earth, as this prevents the loss of valuable fertilising matters into the air. This practice is fully adopted in some places. *e.g.*, in Tinnevelly, with the best results. If the upper portions of a manure heap become dry, the heap should be turned over so as to mix the moister and the drier portions together, and if there be any tendency for the heap to dry up generally, it may be watered slightly with advantage. The covering of the heaps with earth to a great extent prevents undue drying. The great aim should be to maintain the heap in a moist state, so that the whole mass may decay slowly and completely, and thus the fertilising matters of the manure may be preserved and rendered more immediately useful than as they are found naturally.—(C. BENSON, *in Madras Agricultural Bulletin*, No. 81, 1894).

V.—SHIKAR AND TRAVEL.

Elephant-capturing Operations on the Anaimalai Hills.

Elephant-capturing operations by the pit-fall systems were set in working order in the locality of the forest station at Mount Stuart on the Anaimalai Hills by Mr. H. J. Porter, Deputy Conservator of Forests in the season of 1890. For the past five years, therefore, during each of the working seasons which commence in June and end in December elephant captures have been attempted and it may interest some readers of the *Indian Forester* to know the results of the operations and the experience gained. Places were selected in the known runs of the elephants and the pits were dug in groups of three  .

To commence with, about 21 pits were dug in different parts, all, however, being within a two-mile radius of the Mount Stuart Forest station. Since 1890, some 20 pits more have been dug out. The dimensions of the original pits were 12 ft. × 9 ft. with a depth of 10 ft. These are too large and a pit 10 ft. × 10 ft. × 10 ft. is amply big enough. The sides of the pits were made vertical and not sloping downwards as are the pits in Malabar, under Mr. Hadfield; and some two or three feet of brushwood were placed in the bottom of each to act as bedding to break the fall of the animal. The pits were then covered by means of bamboos placed across them and on these were spread grass, leaves, etc. The pits are visited every morning by a Forest guard or watcher deputed for the purpose, and these report to their superior officers whenever a fall takes place. The Range officer in charge or the D.F.O. himself should, however, inspect the pits as often as possible and at least once in a week, to see that the guard and watcher are not humbugging. During the first year, one animal, to which the name of Juno was given, was captured. This subsequently died. In the second year, 1891, four animals were captured, two of which subsequently died and two of which are now living. In the third year, 1892, two extraordinary falls took place by which *seven* animals were captured in *five* pits. I reported this to the *Indian Forester* at the time of capture, 1st September 1892. Out of these seven animals, four are

'owing to the cyclone, were made along dragging paths; but it 'was thought wise to try and avoid this system this year, as 'dragging paths are purposely kept as much as possible on the 'low and level lands, to save the elephants, and this is where 'padauk (*Pterocarpus indicus*) is generally found. The result 'therefore of the average of these valuation surveys would be far 'too high to be taken as representative of the forest as a whole.

'It was therefore decided to run all the valuation surveys due 'east and west as by so doing a fair proportion of hill and valley, re-'presentative of the country as a whole, would be taken in. For 'this purpose points were marked off on the Goplakabung road, 'and on the one side the lines were run due east to the sea, and on 'the other side due west for two or three miles; and besides these 'lines three short lines were run north and south."

The result of these surveys are summarized as follows, per Square mile.

Trees 30 in. and over in diameter ...	... 289
„ 24 „ „ „ ...	... 57
„ 18 „ „ „ ...	... 30
„ 12 „ „ „ ...	... 17
Poles	... 6

or per acre 0·54 trees over 2 ft. in diameter, as against 0·84 trees found in the previous year when the survey was more confined to lower and richer localities.

The artificial reproduction of padauk is being proceeded with, as is the planting of teak and mahogany. The planting is in lines, 100 feet apart, 6 feet in the lines, alternately teak and padauk, and the results have been very satisfactory, especially with teak. Teak plants 1 year old reach from 8 to 12 feet high and padauk of similar age from 5 to 8 feet.

Some of our readers may be interested in the following list of the chief timbertrees which it is usual to fell.

Padouk	Pterocarpus indicus
Pyimma	Lagerströmia hypoleuca
Gangow	Mesua ferrea
Koko	Albizzia Lebbek
Thitmin	Podocarpus bracteata
Chunnu	Croton argyratus
Tonngpeing-ngè	Artocarpus Chaplasha
Thingan	Hopea odorata

The Andamans forests during 1892-93 were under the charge, *first* of Mr. E. G. Chester, *afterwards* of Mr. Dingwall Fordyce, both assisted by Mr. E. M. Buchanan. All these officers are duly commended by Government.

still living. During 1893 two animals were captured and during the present year, 1894, four animals have been caught, all of which are living. I append the following statement giving the names, sex, and height of the animals captured and whether living or not :—

List of Elephants captured up to September 30th, 1894.

Serial number.	Name of Elephant.	Date of capture.	Male or female.	Height.	Remarks.
1	Juno	1890-91	Cow	.	Died (exact date of capture and death not known).
2	Maude	23rd July 1891.	Cow	4½′	Sold on 20th July 1892 for Rs. 300.
3	Ada	24th July 1891.	Cow	5′	Died on 14th February, 1892.
4	Abdul	4th Oct. 1891.	Tusker	6½′	Still living.
5	Elsie	23rd Spt. 1892.	Cow	5½′	Died in June, 1893.
6	Alice	do.	do.	4½	Transferred to S. Malabar in December, 1893.
7	Ranger	do.	Male	4½	Died in June, 1893.
8	Cerise	do.	Cow	7½′	Died on 1st October, 1892 from an injury sustained in the face.
9	Phyllis II.	25th Sept. 1892.	Cow	7′	Still living } these two were captured in the same pit at the same time as were Ranger and Cerise.
10	Jumbo II.	do.	Tusker	6′	do. }
11	Pragasam	do.	Cow	4½′	Transferred to S. Malabar, December 1893.
12	Ranger	23rd July 1893.	Tusker	7½′	Still living.
13	Cerise	20th Oct. 1893.	Cow	5′	do.
14	Forester	10th Aug. 1894.	Tusker	7½′	do.
15	Elsie	18th Aug. 1894.	Cow	8′	do.
16	Penelope	18th Aug. 1894.	Cow	8′	do.
17	Ganesh	4th Sept. 1894.	Male	4½′	do.

It will be seen from the above statement that out of a total of 17 captures, 12 are now living. It may be remarked moreover that the casualties took place amongst the first three years' captures when the attendants, who are local hillmen, called Mulcers,

were entirely inexperienced concerning elephants. During the last two years, I have increased the bed of brushwood considerably and made it a rule to have the bed reach to within 4 feet of the top of the pit. The results speak for themselves : not a single animal has since been injured in the face, although two of the latest captures are the largest animals caught since operations were commenced.

The removal of a capture to the kraals, which are within two or three miles from the pits, is a very simple matter, provided everything is in readiness beforehand. The size of the animal's neck is estimated and a peg is put in the rope so as to prevent the noose going smaller than the neck-size as estimated. This noose is then thrown over the elephant's neck and pulled tight to the peg, the end of the rope being bound round a neighbouring tree ; next, one of the elephant's hind legs is noosed and the end of this rope, too, is for the time being, bound round a neighbouring tree. The neck rope at the peg then has to be tied with twine or fibre to prevent the noose being loosened by the elephant. This operation is, taking it all round, the most risky one connected with the capture. But if proper care is taken there is nothing to fear.

The pit is then filled up by means of billets of wood being thrown in, and as the animal rises nearer the surface of the ground, the two ropes fastening him are pulled tighter around the trees. Eventually he gets out of the pit somewhat fatigued ; the ropes which secure him are then fastened to two tame elephants and the animals are marched in single file (the captured one being of course in the middle) to the kraal and all the ropes are removed. He is watered three times a day and soon made tame by kindness, given sugarcane, etc. Somewhat large animals are generally in the kraal 3 months before they can be taken out ; the little ones of 4 ft. or 5½ feet high, however, I have removed within 3 weeks of capture.

The work of capturing elephants is an exceedingly interesting one, and only needs care and constant supervision to render it successful ; and certainly the more one has to do with these animals the one more is bound to recognise what intelligent, useful beasts they are. Having left the south Coimbatore District, I regret much that for some time, at least, I shall have no connection with this kind of work entrusted to Forest officers.

PALAMCOTTAH,
Tinnevelly Division.

H. B. BRYANT.

Tiger shooting in the Saharanpur Siwaliks.

The following extract is from the 'Pioneer' of January 8th. Enquiries from the officer who shot the tigers shew that the place where they were shot was Gular Sot, about 2½ miles north of Dholkhand. He says that he took the cub to be a small leopard and did not find out the truth until it was dead; and that a Forest Guard who was with him behaved very well. Five tigers have lately been accounted for in the Dún and Saharanpur, including these, the one shot by the Lieutenant-Governor near Kansrau and another near Khara by the Ex-Amir of Cabul. They seem to have been on the increase in numbers lately.

"A Forest Officer had rather an exciting adventure in the 'Siwaliks a few days ago while stalking for deer. He had seen a 'sambhur stag on the opposite slope of the "khud," and leaving 'one of his men to direct him he crossed over and had hardly begun 'stalking in the direction pointed out when he came suddenly on a 'tiger cub about fifteen yards above him. He tried to get round 'and above the beast, but it kept following along, growling and 'snarling, until the suspense becoming too great, the sportsman 'fired and killed it with two shots. He had hardly time to reload 'before the tigress was seen prowling along a little way down the 'slope, and it fell dead to the first shot. The animal, which was a 'very fine one, was evidently looking for its cub, and it is fortu-'nate that she was spotted in time and killed outright, or the affair 'might have ended otherwise."

VI.—EXTRACTS, NOTES AND QUERIES.

African Bamboo.

One of the most useful vegetable products in the British Central Africa country is the bamboo, of which there are at least two species, one only found on the very high mountains, and of quite a dwarf variety, of no account in commerce ; the other also growing on the mountains, but at a lower level, being almost, if not quite, identical with the common Indian species, though it is found in the two forms known as the "male" and "female" bamboo. That these two terms indicate any real difference of sex Mr. Johnston scarcely thinks. In his report on the administration he adds :—I

again the difficulty arises that certain timber is required for every-day use on the farm, and it is difficult to draw the distinct line between the two.

It has been suggested that a strict dimension law should be enacted, limiting tree-felling to timber that has attained certain dimensions. The logs have much reduced in size within the last few years. The time was when 9 in. timber was a very moderate log, now it is considered quite a decent size, and if a limit is instituted at all it will be on a much lower basis. In neighbouring countries, 5 and even 4½ in. logs are cut, and the quantity of the favourite 2 × 4 scantlings are usually sawn out of 6 in. logs. In Norrland, however, such small logs as these are not used. It has been proposed to place the limit at 21 centimetres at a height of 1·5 metres from the root, which would mean about 8 in. top. It is, however, probable that the meeting which was specially arranged at Stockholm will hardly have seen its way to agree to this, and that a somewhat smaller minimum size will have been established.

Since writing the above we have received the following telegram from our Stockholm correspondent :—"The meeting held here to-day (Nov. 20) resolved by a majority of eleven votes to six to endeavour to carry a measure through the Riksdagen, prohibiting cutting of all trees below 8¼ in. diameter at a height of 5 ft. from root, under bark, this having reference to forests in Westernorrland and Jemtland." It will be seen that the limit is below what was proposed, and will practically mean logs of 7 in. top at the usual height up. There is every probability of the law passing, being backed up by the shippers. It will be a severe restriction, and likely to go a long way towards checking the heedless demolition of forest.

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The Reproduction of High Forest.

(By M. Ch. Broillard in the Revue des Eaux et Forêts.)

In reply to numerous questions which have been put to me regarding regeneration fellings by area in High Forest, I think I cannot do better than give the history of the method. It was in seeking the best method of obtaining the reproduction of forests by seed that I became convinced of the necessity of fixing high-forest fellings by area and not by volume. It is therefore from a cultural point of view that I have been led to advocate fellings by area and I venture to presume that there are few foresters who are satisfied with the cultural results of fellings by volume.

The idea of the regular return over the same area of the regeneration felling first struck me in the Forêt de Haye. This forest had to be worked by the uniform system in eight working circles containing 10,500 acres. Having to organize these fellings from the year 1863 under MM. Parade and Nanquette, work with whom was always a pleasure, I sought first for the best disposition to give to the seed fellings which were regulated by area; it was the first working plan in which this was the case. The species in this forest are oak and beech with hornbeam (abundant) maple and others. At first we were extremely cautious, feeling our way gradually by successive trial. Work was carried out annually at several different places and as the years with their changes succeeded each other, we were able to compare the different results. Finally, the seedlings of the different species, more or less favourably mixed, established themselves everywhere. At the end of ten years, after a suitable felling repeated after five years, the regeneration was an accomplished fact. I was even able to formulate the idea that in returning every five years, it was possible to dispense with an examination of the soil to ascertain the condition of the young crop, this being in Haye everywhere complete ten years after the seed felling.

From this to regularly ordered fellings was but a step. These I mentioned in the "Traitement des Bois" in 1881 and recommended high forests of oak to be worked by removing one tree in

four every five years. The idea was not sufficiently developed and escaped notice and fellings by area were not clearly defined. From 1881 to 1892 in the Saone-et-Loire the Ain and on the Jura even, I had again ample opportunity for observation in the fellings which were carried out or were in course of execution in high forests of oak, hornbeam, beech and silver fir. For one thing, I found that in fir forests no felling can extend to one third of the volume without endangering the forest. This was one important step.

In the Côte-d'Or we succeeded in putting into most perfect order the operations to be carried out in the forest of Citeaux, thanks to the fellings by area in the first period—localities divided into 30 equal portions. In following closely the marking of the trees, I was able to note that the removal of one oak in four, one beech in three, and one hornbeam in two, always gave a good result in any one of the successive regeneration fellings.

Finally, having found in this region several coppices being worked with a view to their conversion into high forest, I was able to formulate clearly the order of the successive regeneration fellings all of them by area (See *Revue des Eaux et Forêts*, 10th June, 1890). I was supported in this system by two friends who sought, as I did, order and good cultural results. Previous to this, several endeavours had been made to simplify high forest working plans but without result. This time, if I am not mistaken, the solution of the difficulty is attained. Based on the area, in high forest as well as in coppice, the fellings allow a regular order and a return at fixed intervals, which, if the volume be taken as the basis of the possibility, it is impossible to arrange.

I have been told that I am wrong about one oak in four and one beech in three, and that it is rather one beech in four and one oak in three which ought to be cut.

The beech has much denser foliage than the oak and the young seedlings are very sensitive to drought and frost. Nevertheless if from a crop where the canopy is complete only one beech in four is removed, sufficient light is not given to the soil for vegetation to establish itself, the soil remains covered with the dry beech leaves, and any young seedlings which may appear, die off at once. In fact by the growth and spreading of the crown, the beech fills up in two or three years any gaps made by such a light felling. It is at least one in three, and that generally the biggest of the three, which should be removed to give the light necessary to begin with and for the young seedlings afterwards in any subsequent regeneration felling.

From the objection referred to above, I am led to conclude that seed fellings are often carried out too timidly in beech forests and still more so when oak happens to be mixed with the beech. For the benefit of the beech and still more for the benefit of the oak, it is at least one beech in three, and generally the biggest of the three, which should be cut in any of the regeneration fellings.

The next question is, whether the removal of one oak in four, choosing the feeblest and least promising, is equally well justified. Does this give enough light for a young seedling of such a robust and light-demanding species to establish itself and develop? There is no doubt that it does. Examination will show that in high forests of oak the most reliable seedling and the one which will force its way through the undergrowth which appears after a felling, is the one which had already established itself before the cover was opened. And it does not require many of these to constitute later on a favourable crop of saplings, it is even preferable that they should be scattered through such a crop but pushing their way through it and predominating over the others around them. In removing one oak in four, and generally the least favourable in each of the successive regeneration fellings, one secures gradually the establishment, maintenance and development of those excellent oak saplings among the undergrowth which increases but slowly before the invasion of such species as the birch, poplar and hornbeam and without even the beech being able to smother them, owing to the cover which hinders its rapid growth. In short, the removal of one oak in four will be sufficient to secure the reproduction of the oak, while at the same time, it keeps down the undergrowth and inferior species.

Finally, in the case of a forest in which oak and beech are mixed, whether the one or the other species be more abundant, it will always answer well as regards the reproduction of the two species, to cut out every five or six years one beech in three and one oak in four, whereas removing one oak in three and one beech in four would inevitably finally result in a pure forest of beech. The seed of the oak is much heavier than that of the beech and it is only natural that in order to obtain the reproduction of the former, it should not be thinned so heavily.

The above arguments, which I do not pretend are either complete or perfect, might be repeated for every species without affecting the main fact. Experiments can easily be made to test the truth of these statements. In any high forest or coppice undergoing conversion, a certain area can be set aside in which the different fellings can be ordered so as to remove the required proportion of the different species, whereas in the neighbouring forest, the old defective method may be adhered to. It will take ten years to fully obtain the required results from the time the fellings are made, but conclusions may be drawn by comparing the two methods. Coupes regulated by volume do not prevent these experiments being made, they only hinder the periodical return of the fellings over the same area.

(To be continued.)

A. F. G.

The Rain Tree for Avenues.

In the Tindivanam Taluk of South Arcot District, the rain-tree (*Pithecolobium Saman*) has been planted over short distances along some of the public roads, for instance, on the Tindivanam-Salavadi branch road, Tindivanam-Merkanam main road, &c. This tree is said to have been first introduced into the Taluk some 10 years ago by Mr. Weld, then Sub-Collector of South Arcot, who has left permanent marks of his love for arboriculture, in the various topes planted during his time in the neighbourhood of Tindivanam. The rain-trees on the Tindivanam-Salavadi road appear to have been planted 10 years ago, and some of them have already attained a girth of 5 feet and a height of about 35 feet, thus shewing the remarkable rapidity with which this species grows. The crowns of the trees on both sides of the road have already formed a complete leaf-canopy by the meeting and interlacing of their lateral branches. The road is formed by an embankment, on the slopes of which the trees are planted. On both sides of the road, water collects during the rainy season and remains for about 4 months in the year. During the remaining 8 months of the year the trees do not suffer for want of water which is within easy reach of their roots, being hardly 5 feet below the ground-level. Elsewhere, too, I have observed the rain-tree growing vigorously on the bunds of tanks, ponds, wells, &c, and it may therefore be concluded that it is a lover of moist but well drained localities.

In order to ascertain the area shaded by the crown of a well-grown rain-tree I took some measurements in the belt of rain trees (believed to be 10 years old) planted between the tenth and eleventh mile on the Merkanam-Tindivanam road at about 1. P.M. The average result of 3 separate measurements of different rain-trees showed that the vertical shade of a tree extended to a radius of about 20 feet all round its base. At the same place where the leaf-canopy was more or less complete, I found that the distance across the road from the foot of one tree to that of another was 12 yards, and on the same side of the road the trees stood the same distance apart. Their girths varied from 4 to 5 feet.

Judging from the short lengths over which the rain-tree has been planted along the roads in this Taluk, I am led to think it was originally undertaken as an experiment to test its suitability and adaptability for avenues. If my surmise is correct, then I may say that the result of the experiment is a great success and claims for the rain-tree much more attention than it has hitherto received as an avenue tree.

From what I have seen in a small nursery of young plants of this tree, I believe that it is very easy to raise them from seed. I have seen large seedlings of 4 to 6 feet in height transplanted from the nursery with perfect success. Apart from these advantages, its peculiar system of more or less verticillate branching,

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(To be continued.)

A. F. G.

Flowering of Strobilanthes in Burma.

From time to time I have seen short paragraphs stating that Forest Officers have noticed in places the periodical flowering of different species of Strobilanthes. It may interest readers of the *Forester* to hear of the protective effect from fire, exerted by an extensive flowering of a species of Strobilanthes in the Upper Chindwin.

Any one who has once seen the huge jungle fires which rage unchecked through vast tracts of forest, may imagine the damage which is done by one when it passes through a teak forest, especially if it occurs late in the dry weather, after the first showers which always fall in this Division in April, when most of the teak seed has fallen and germination has commenced.

On the hill range running parallel to the western bank of the Chindwin are some of the finest teak forests in Burma, consisting of teak mixed with other species and 'tinwa' bamboos (*Cephalostachyum pergracile*). The forests are open ones, for Burma, and favour the growth of coarse grasses, these together with fallen leaves when dry give an ideal fuel for fires, and yearly about 60 per cent of the whole tract is burnt over, the fires always starting from the carelessness of travellers in throwing lighted cheroots into the grass, or leaving their camp-fires alight. During the months of March, April, and part of May, my work took me to these forests and I at once noticed the huge masses of a blue-flowering herb varying in height from 3 feet in dry and open ground, to 6 feet in shady and moister localities. From a spectacular point of view the sight was magnificent; it seemed as if a green carpet with masses of blue as a pattern had been spread

over the forest and I was delighted to get a change from the dull drab colouring of the dry weather, but as I had to walk all day long through this jungle, my spirit soon revolted and I was no longer an aesthetic. The physical difficulty of forcing one's way through this dense mass of jungle with the sun pouring on me was considerable, add to this immense numbers of honey-bees attracted by the flowers, who strongly resented in a painful way being disturbed; also the strong smell of the flower and the pungent essence of the plant, which penetrated everywhere, into ones mouth and eyes, making the latter smart and giving the former a bitter thirsty feeling, which was difficult to get rid of, made me soon wish the plant had taken to flowering in some other division. The Shans told me that this plant was called "Moyan" and flowered once in 6 years, which coincided with their festival to the bee nats (spirits); they seemed to think that the festival was the cause of the flowering and told me a long and interesting folk-story of the doings of the spirits which this festival commemorates.

On examining the plant, I found it was a species of Strobilanthes but could not find it in "Kurz;" however, through the kindness of Mr. Gamble it has since been identified as *Strobilanthes rufescens*.

Early in April the plant seeded and all that remained was an immense mass of dry stems standing close together wherever one chose to go. As last year the seeding of the teak in these forests had been very good I was very much put out, as I thought at once that not one of the seedlings would survive the particularly fierce fires which were sure to sweep this year through the forests, but as April wore into May and what fires that did occur were uncommonly feeble and spread over small areas, this was noticed by me and also that the fires this year, instead of as usual raging several feet high over large tracts, were confined to small flames licking along the surface of the ground and soon dying out. I was puzzled and set about trying to account for this. I then noticed that the dry stems of the "Moyan" did not burn readily, as in places where these low fires had gone through the jungle the dead stems of the "Moyan" were still standing, only slightly charred and the fire had not spread, whereas on the hill tops crowned with Engdaing in which "Moyan" did not grow, the fires had raged with their usual fierceness. I can only account for the fact in this way, that the dense growth of the "Moyan" checked the growth of grasses and that the dry stems standing with slight intervals between them were nothing like such good fuel as dense masses of dry grass and weeds. I also thought, however, with what truth I cannot say, that the essential oil of the "Moyan" which gives it its peculiar and disagreeable odour, was not inflammable. It is also to be noted that birds did not seem to be attracted by the extensive seeding, only bees were, so that this flowering has had a very marked effect on the wax revenue of this division.

C. W. A. B.

Pyingado for Wood Pavement.

Sir,

In continuation of my letter of 16th ulto. published at page 452 of the *Indian Forester* for December 1894, I forward you the note with which Mr Bagley has kindly furnished me in reference to Pyingado. It is unfortunate that none of the approaches to Offices which are laid with wood pavement are under the Railway branch in Rangoon, as Mr. Bagley's opinion would then have had a more direct and practical value than can be attached to it regarding the particular point under consideration, *viz.*, the utility of Pyingado *for wood pavement*. He writes as follows :—

"We tried the pyingado blocks for paving the *flooring* of platforms and workshops only but not for road work. As a flooring, the blocks have stood 10 years, wear *perfectly*, not ½ per cent requiring removal during that time."

"I have no experience of pyingado blocks in street paving, but do not know of any Indian timber in ordinary use that can compare with it for hardness and durability, and cannot imagine a better material for any work where these qualities are necessary. Any statements made to the contrary are probably founded on experiments made with green unseasoned timber, and that not properly selected."

The whole matter is one that has many other aspects besides the mere question of durability ; but this is neither the time nor the place—nor have I access to the requisite *data* in the way of official correspondence,—for attempting to discuss the subject in all its bearings. Even such a trifling matter as the name of the wood may *possibly* count for something in London. Hence it might perhaps be more advisable to bring it to notice and push its introduction simply as *Ironwood*, rather than by calling it by any of its Indian names, Pyingado, Irul, or Jamba; *Xylia dolabriformis* would of course damn the chance of the best wood that ever existed, so that that depressing scientific name should invariably be suppressed

J. NISBET.

DEHRA,
20th January, 1895.

NOTE.—We certainly think 'Indian Ironwood' would be the best name for trade purposes.

HON ED.

Rate of Growth of Teak.

DEAR SIR,

In the "Forester" for June, 1893, whilst reviewing the Forest Administration Reports, 1891-92, you have asked if in Nilambur Plantations we can beat the dimensions you quote for the growth of teak at Makum, *viz.*, height 82 feet., girth 8 ft. 6 inches, girth 3 ft. 2 inches, in a plantation 16 years old. There are no plantations here of that age for comparison. In a sample acre taken from 1st class soil (alluvial) in a plantation 19 years old, the two biggest trees measure :—

(1) Girth at 4in. 6 feet = 3ft. 8in.
(2) do. = 3ft. 0¼in.

The bole of the former is 60ft. in length, but, there being no use for the branch wood, the full height is not measured.

It is, however, unfair to make the comparison only for two trees, as, if picked out specially, a few trees much bigger could be found growing on the outside of the plantation.

As I have measured 23 sample plots you will understand that I cannot at present give you all the measurements, which doubtless will find their way to you in time, but the measurements in the "Jubilee plantation" (1844) are as follows:—

No of trees per acre,	68.	
No of trees measured	60.	
Average girth at 4feet 6in.	53·64	inches
" " at centre	40 68	"
" height of bole	68ft.	
" cubic contents	48·99 c. feet.	
" Annual Increment (current). girth at 4feet 6in.	·675	in.

There are a number of trees in the plantation over 6 ft. in girth of which 31 have been measured in order to obtain the rates of *circumference at centre : circumference at breast height.*

The biggest girth is 8ft. 8in. with centre girth 5·4ft. but with a short bole, *viz.* 52ft. (The greatest length of bole measured was 78ft.) The bole at breast height is very much fluted, though the flutings do not go far up the trunk.

NILAMBUR, P. M. LUSHINGTON.
24th January, 1895.

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NILAMBUR, P. M. LUSHINGTON.
24th January, 1895.

Palmyras

SIR,

Surely Mr. A. W. Lushington in his letter to you about Palmyras is very wrong in writing about "black wood" in the heart of this tree. I have never known any Palmyra, whatever its age or height, which was black in the centre, except possibly from rot.

The "black wood" is always the outer rind or cortex, I should say, of the tree. This greater density and blackness of the outer part of the tree is due the to direction the fibrous bundles from the leaf take, *viz.* first direct from the leaf-stalk inwards, when being full of sap and imbedded in parenchyma they cause the white appearance of the centre of the tree which is particularly liable to rot. The bundles then tend outwardly, anastomoze, and join other and older leaf-fibres in the outer part of the tree. I shall be glad to be corrected if I am wrong.

J. G. F. M.

Note.—Mr. Lushington used the words 'black wood in their interior' and 'black in the heart' but it never occurred to us that he misunderstood the structure of a monocoty ledonous stem. Even if not an anatomical botanist, no intelligent person who has ever cut open a palmyra could make a mistake on the subject. That some trees have a hard dark wood and others a soft wood, we have ourselves noticed, though we doubt if the soft wood variety becomes harder by age. Perhaps the difference is one of sex and this could easily be determined.

Hon. Ed.

III.—OFFICIAL PAPERS & INTELLIGENCE.

V.—SHIKAR AND TRAVEL.

A Narrow Shave.

Some years ago in the Seoni district, C. P. I camped at a village where a Gond had had his thumb clean bit off by a tiger a few days previous to my arrival. While loading a cart in the forest he heard something rushing at him, turning round and seeing the tiger he shouted and stretched out his arm, curious to say, the tiger did not make his charge good but snatching at his hand turned tail. The thumb was taken off almost as neat as if an operation had been performed. By the application of Neem leaf poultices, inflamation was kept down and the man's hand healed up all right but he thought one such escape was enough for a life time and shortly after the Gond settled in a village in the open country.

This tiger after chawing up some half dozen persons fell to my gun handled by my native Shikarrie. After several failures at "beats", I tried the plan of feeding him in a quiet nook inside the reserve. I then had a pit dug and from this vantage ground stripes got his quietus while making a rush on the bait; he was shot before he could kill the buffalo that was tethered in front of the pit.

E. D.

A Lady's Shikar in Oudh.

We hear that during the Inspector-General's recent tour in Oudh, his daughter, Miss Ribbentrop, had some excellent sport, getting a tiger, a panther and a fine stag. She shoots with a ·500 Express with 5 drams of powder. We offer her our congratulations on her success and our best wishes to her father and herself for their approaching tour round the world.

Bragantia Wallichii.

By David Hooper, Government Quinologist Madras.

"Alpam" is the name of a shrub belonging to the natural order Aristolochiaceæ, growing on the western coast of India, Rheede van Drakenstein, the Dutch Governor of Malabar during the latter part of the seventeenth century, seems to be the first botanist who mentions this plant, as "alpam" is figured in 'Hortus Malabaricus, vol. vi., t. 28, published in 1686-1703. Lamarck, in the botanical portion of 'Encyclopédie Méthodique' (1783), names the plant *Apama siliquosa*, but as Lamarck's knowledge of it was wholly derived from the 'Hortus Malabaricus,' it is most probable that 'apama' is a misprint for 'alpama,' and that the generic name was intended to be taken from 'alpam,' which is Rheede's name.

Bartolomeo, * in his 'Voyage to the East Indies,' says, "The only Malabar plant which I can with certainty call an antidote to poison is a shrub about three or four feet in height, named alpam. The root is pounded, and administered in warm water to those who have been poisoned. A Malabar proverb says, 'Alpam agatta Veszam poratta.' (As soon as the alpam root enters the body, poison leaves it.) The poison referred to by this traveller is that of venomous snakes, especial y cobras, which are very plentiful in the jungles of the western coast. Dr. Ainslie alludes to the plant (in 'Materia Indica,' 1826, vol. ii., p. 13) on the authority of Bartolomeo, and recommends it for further investigation, although he had not met with a specimen of the drug, and did not know its botanical origin.

Bengal and Bombay writers on Indian drugs make little or no allusion to 'alpam,' on account of its habitat being confined to the Malabar coast and Travancore. Dr. Dymock found the plant growing in Goa, and merely recorded what others had said about it in 'Materia Medica of Western India,' and because no authentic specimen could be obtained for description and examination, it was omitted altogether from 'Pharmacographia Indica.' Mr. M. A. Lawson, during a recent botanical tour in Travancore, met with *Bragantia* in the hill ranges, and has placed some of the roots at my disposal.

Like other plants of this order, alpam has been supposed to have virtues in the cure of snake-bite, the juice of the leaves and the root being the parts used. Drury states that the whole plant, mixed with oil and reduced to an ointment, is said to be very efficacious in the treatment of 'psora' or inveterate ulcers. The juice of the leaves mixed with Vassumbu root (*Acorus calamus*) the root itself rubbed up with lime-juice and made into a poultice and externally applied, are the chief modes of administering it among the natives.

Bragantia Wallichii, R Br., is a dioecious shrub; leaves oblong lanceolate, three-nerved at the base, 5-8 inches by 1½-2 inches; flowers in small, irregular, few flowered cymes; tube of perianth smooth, lobes acutish; anthers nine, triadelphous; pistil short; stigmas nine, radiating; fruit a capsule (like a siliqua), slender, three to four inches long, terete; seeds one-tenth inch long, 3-gonous, deeply pitted

There are three species of *Bragantia* natives of India and Malaya. *B. tomentosa*, Blume, possesses intense bitterness, and according to Horsfield is employed by the Javanese as an emmenagogue.

* Fra Paolino de San Bartolomeo was born in Austria in 1748. He joined the Carmelites, and came out to Malabar in 1774, where he was successively appointed vicar-general and apostolic visitor. He remained in India for fourteen years, studying the languages, literature, and religions of the people. His 'Viaggio alle Indie Orientali' was published in Rome in 1796. He died in 1806.

The roots of alpam are light brown in colour, knotted and twisted, about one inch in diameter at the thickest part, and tapering. The thin cortical portion is soft and corky, and may easily be removed by scraping with the finger nail. The substance of the *root is tough in consistence. The odour of the bruised root* is terebinthinate, and the taste nauseously bitter. A transverse section of the root shows a rather remarkable appearance, although the peculiar structure of the wood of the Aristolochias has been pointed out by Lindley, Decaisne, Von Moh., Duchartre, and others There are not very evident concentric zones in the wood, but it is broken up in a radiating manner into thin wedge-shaped masses extending in some instances from the cambium to the centre of the root. There is no proper pith, and the parenchymatous system is distributed in alternating layers with the wedge-shaped bundles of wood, like exaggerated medullary rays. The wood is yellowish-brown, and consists of long wood-cells, with some porous vessels running down the centre of each bundle. The parenchyma contains a large quantity of starch, and is almost white in colour.

A description of the structure of the wood of *Bragantia Wallichii* with a figure of a transverse section was recorded by Dr. Maxwell Masters in a paper* read before the Linnean Society about twenty years ago. The sketch of the section of the stem shows a very eccentric arrangment of the wood, with irregular zones extending laterally. This indicates a plant with a scandent habit; but Mr. Lawson's specimens were not of that character, and some sections of young stems attached to the roots of these samples showed a regular arrangement of the wood as from a round stem of an erect plant.

The powdered Bragantia root yielded some yellow, tenacious, resinous substances to ether, which did not crystallize on standing The mass was heated on a water-bath to dissipate essential oil, and the residue was treated with ammonia water, which only partially dissolved some resin with a yellowish-brown colour. The alkaline mixture was shaken with ether, and the ethereal layer separated and evaporated, left a soft neutral resin of a golden brown colour, giving a reddish-brown solution with sulphuric acid The clear alkaline solution was acidified and again shaken with ether. The ethereal liquid was fluorescent, and left on evaporation a brittle, golden-brown resin acid. These resinous bodies were not analogous to aristin, found by Dr. Hesse in *Aristolochia argentea*, by Dr. Warden in *A. indica*, and by myself, only lately, in *A. bracteata*.

After removal of resins from the powdered drug, rectified spirit extracted an alkaloid which formed a combination in the plant soluble in water. The aqueous solution of this extract,

* "Remarks on the Structure, Affinities and Distribution of the genus *Aristolochia*, with descriptions of some hitherto unpublished Species." Read February 1873. *Journ. Linn.* Soc., xiv., p. 487.

shaken with chloroform, afforded a residue containing some resinous matter with an alkaloid. The solution was then treated with ammonia, which caused a precipitate, and again shaken with chloroform. The chloroformic extract left a pinkish coloured residue consisting of impure alkaloid. This was dissolved in acetic acid, rendered alkaline with ammonia, shaken with ether, and the ethereal layer left a whitish residue of almost pure alkaloid. This base had an alkaline reaction, it gave a greenish-red solution in sulphuric acid, a yellowish one with nitric acid, destroyed the red colour of permanganate of potash, and afforded a crystalline acetate. Acidified solutions of the alkaloid gave precipitates with alkalies, insoluble in excess also with tannin, iodine in iodide of potassium, potassiomercuric iodide, potassium ferrocyanide, and phosphomolybdate of ammonium. The alkaloid and its salts were intensely bitter; it is probably allied to aristolochine, the source of bitterness in certain plants of this order.

Most of the alkaloid was removed by the spirit extraction, only a small quantity remaining in the extract subsequently made with water. The watery extract also contained a substance which reduced Fehling's test, and on allowing the evaporated extract to stand for some weeks, some hard, white, transparent crystals separated out, which were related to dulcite.

The following table gives the results of the examination of the powered root of *Bragantia Wallichii* or "alpam."

Neutral and acid resins, and ext. by ether ...	1·48
Alkaloid, etc., ext. by spirit	3·43
Water extract	6·71
Starch and fibre	77·02
Ash	3·35
Moisture, etc., ...	8·01
	100·00

(*Pharmaceutical Journal.*)

A Forest Flora for Bombay.

We hear that a proposal is on foot for the preparation of a Forest Flora for the Bombay Presidency and that the work is to be entrusted to Mr. W. A. Talbot, Deputy Conservator, whose botanical knowledge is so well known and to whose recent 'List' we recently drew attention in our pages. We hope the report is true—it is a chance which may be missed, if advantage is not taken of Mr. Talbot's special knowledge and qualifications. We hope that the work will be not merely botanical, like the Burma flora of Mr. Kurz, but prepared on the lines of Brandis' N. W. and C. India Flora with full notes on geographical and economic points.

Fruit Culture on the Himalaya.

The experience obtained in regard to fruit cultivation on the hills has now reached a stage at which it deserves to be brought under attention for the benefit of those who may be tempted to take up the pursuit as a means of livelihood. The industry is still in its infancy, but it undoubtedly possesses great capabilities for future development, and if carried out under proper management should prove to be a source of much profit. The demand for English fruit in India is far in excess of what can now be supplied, and it would take many years for fruit growers in this country to experience the disadvantages which growers in England have to contend with in the low prices offered during seasons of plenty. The most important considerations in all attempts to grow fruit successfully on the Himalaya are—firstly, a suitable climate, and secondly an accessible market. Unfortunately it is not easy to find localities where both of these conditions are combined; for as a rule, the best fruit-growing districts are situated too far away from any market of sufficient importance, and fruit growers in these parts are at present much handicapped by the difficulties and expense of transport. This obstacle may in time become lessened as communications are improved. In order to expedite the despatch of portable fruit it might be possible in some cases to adopt wire carriage in the same manner as railway sleepers are brought down from the leased forests of Tehri-Garhwal. The principal markets for Himalayan fruit are, of course, the various hill stations, which are situated for the most part on the outermost ranges. At some of those hill stations there are Government fruit nurseries; and a considerable quantity of fruit is raised by private enterprise. But the climate of the outer ranges is too uncertain; favourable seasons may occur occasionally, but in the long run fruit growing there is found to be too precarious an occupation to be depended upon as a means of livelihood. Thanks to Mr. Coldstream, lately Deputy Commissioner of Simla, we are now in possession of some extremely valuable facts regarding fruit culture in Kulu and in the neighbourhood of Simla. Mr. Coldstream has for several years taken much practical interest in the subject, and he has now put together in printed form some very useful information consisting of notes contributed by a few of the most experienced growers in Kulu and elsewhere in the Punjab. The results, as far as they go, are decidedly encouraging.

A great variety of fruit can be grown in Kulu owing to differences in elevation. Apples, pears, plums and cherries succeed best at the higher altitudes, *i.e.*, at or above 6,500ft.; at about one thousand feet lower is the proper elevation for apricots and peaches, whilst oranges, grapes and figs can be grown to best advantage between 3,000 and 4,500ft. above the sea. Apples and

pears are grown to great perfection in Kulu. Consignments of these fruits are occasionally received in Simla during the autumn months, and many persons there can testify to their excellent quality. Captain Lee says that most of the varieties of English and American apples that he has tried have succeeded at Dundrole (5,000ft.) Captain Banon, writing from Manauli, the elevation of which is 6,400ft. says:—"All the English varieties I have yet experimented with have answered admirably They seem to improve as regards flavour, size, and colour, and usually ripen a month earlier than in England....Some English apples, as for instance, Cox's Orange Pippin, which is considered the most delicious apple in England, the soil and climate of this place seem to suit perfectly; and if one grew apples simply for profit one should grow nothing but this sort for the Simla market." Mr. Donald of Dobi reports very favourably of the apple trees in his garden, the elevation of which is about 4,000 ft. only above the sea. Buds from English varieties were put on to indigenous trees, and the stocks being large, the trees fruited after four years, and have ever since borne heavy crops every alternate year Pears do well at Manauli, but not as well as apples. Captain Banon says that the indigenous medlar pear called *shegal* (*Pyrus Pashia*), and which is abundant in Kulu, "answers admirably as stock for English pears, medlars, and quinces. If anything, this place is a little too cold for pears in some years....Louise Bonne of Jersey is the most profitable pear to grow here for market, through Marie Louise and William's Bon Chrétien also grow well and with a superior flavour to the fruit grown in England." Mr. Donald of Dobi says that pears budded on the quince stock are the most prolific and can stand more moisture.

That the apricot grows abundantly all over the hills everyone knows: it might, in fact, be called the potato of the Himalayas, but the ordinary kind would not attract the palate of a gourmand. Mr. Carleton's experiments with Kashmir apricots at Ani, a village in Kulu at 3,500ft., have proved a remarkable success. He says:—"The native apricot in this warm valley was not prolific, and from analogy, we concluded that the place was too warm for the Kashmir or English variety. We, however, introduced 10 trees from the Government Garden at Lahore. They grew very vigorously and began to bear fruit the fourth year. They are even more prolific than the native variety in Kulu valley. The fruit ripens about the 15th or 20th of June. I should advise the extensive cultivation of the Kashmir and English apricot in all the lower hills. The successful introduction of the famous Kashmir-American fruit drying machines into Simla would enable enterprising persons to establish a very profitable industry in preparing dried apricots for the Indian markets." Captain Banon notices this important difficulty in regard to the cultivation of the apricot. "For several years past," he writes, "I have noticed that the first

ripe apricot and the monsoon rains arrive together on the same day. The effect of the rain is to wash all the flavour out of the apricot, cause the fruit to split open, and prevent its ripening properly. Sometimes, after the first burst of the monsoon, we get ten days or a fortnight's fine weather, when the apricot ripens perfectly and is not wanting in flavour. I agree with the Revd. Mr. Carleton in thinking that good varieties of the Kashmir, and perhaps English, apricots might be introduced into the villages."

Mr. Coldstream, in an editorial note of his report says :—"Peaches of excellent quality have been grown by Mr. Carleton at Ani in Kulu, from peach stones imported from America without grafting. American peach stones have been imported in considerable quantity and distributed in the Simla District and elsewhere. Inquiry was made of Mr. Carleton in August 1893, regarding some remarkably fine peaches sent by him to Simla." Mr. Carleton replied :—"Nine years ago we received from Philadelphia some peach stones taken from a variety of very choice peaches. We planted them here and nearly all germinated ; with one exception they were all transplanted to a rocky and rather poor soil ; one was left in a rich soil where it germinated, and has never had any cultivation whatever and is now double the size of the others that were transplanted to a poor soil. All these have been mulched and highly cultivated, but still remain somewhat stunted ; all bear the finest fruit. Some of the peaches have measured more than 10 inches in circumference ; most of them are superior to the fruit of the grafted trees sent from America. They began to fruit when four years old." The common plum of the hills, usually known as "Aru Bokhara," is abundant in Kulu, and does very well, Capt. Banon says, as stock for English plums, which thrive well and bear early and heavy crops. He also states that cooking-plums improve so much in flavour and sweetness that they become in reality dessert plums. Captain Lee also reports favourably on plum cultivation at Bundrole. As to cherries, Captain Banon says :—"All kinds of English cherries, red, black, and white Learts, ripen well here ; but, if anything, the climate is a little too warm for them. They ripen, as a general rule, early in June, and are the first fruit to come into the market. They would not be very profitable to grow as they do not bear carriage well. If the Post Office were to halve their rates for the parcel post a good trade might be done with the more perishable fruit ; but at present few people can afford to pay 8 annas a seer on consignments of fruit, though they would be willing enough to pay 4 annas." The wild cherry is naturalised in Kulu and can be used as stock for English kinds. Grapes, especially the hardly American sorts, have been found to do well with some time and trouble. They would certainly be a remunerative crop. An important point with regard to vine-culture in this country is to secure early varieties which will come

into bearing before the advent of the heavy monsoon rain, or late-bearing varieties which will give fruit after the rains are over.

In connection with fruit growing, we must not omit to take account of the walnut, a tree the growing of which ought to be encouraged by every possible means, not only in Kulu, where it grows to perfection, but throughout the Himalayan Districts. Mr. Carleton observes that in former times in Kashmir, Chumba and Kulu, the only use of the fruit was the production of oil to adulterate ghee. But now the demand for walnuts in the plains is greater than the supply. Captain Lee says he has never seen finer walnuts than those grown in Kulu. In Jaunsar, beyond Chakrata, they are also very fine, especially the thin-shelled variety. Considering how easily the fruit can be distributed to distant markets, walnut cultivation ought to prove a very profitable undertaking. The chesnut is another tree of which it is very desirable to extend the cultivation in the Himalayas, but the difficulty is to find a soil and climate where they do well. Sir Edward Buck has devoted much trouble to encouraging the growth of this tree in the neighbourhood of Simla.

Mr. Carleton's experiments with oranges in Kulu have shown that the Malta Orange can be grown successfully on the lower hills up to an elevation of 4,500 ft. "In California," he says, "orange cultivation is extending up to the rich valleys of the Pacific slopes, and I see no reason why in these lower hills, orange cultivation should not be a success. I learn that oranges sold from the Government garden in Gujranwala, and other gardens, usually fetch from 5 to 8 rupees per hundred, and it is quite certain that Maltese oranges sent to the Simla market in April, when there is little fruit for sale, would fetch Rs. 8 and perhaps Rs. 10 rupees per hundred. An orange tree 8 years old that gives an annual crop of over 200 oranges could give the owner a profit of 16 rupees, and that only on 10 feet square of ground."

Many other kinds of fruit can be grown successfully in Kulu, such as strawberries, gooseberries, currants, raspberries, figs, &c., but they are all of too perishable a nature for safe carriage to the nearest market. There is no reason, however, why they should not be preserved either as jam or bottled fruit, and the same suggestion would apply equally to peaches, apricots and pears. The art of preserving fruit is one quite apart from that of its cultivation, and requires a very different kind of experience. These two industries might, however, be undertaken by a company employing experts in each department, and such a business, if properly managed, could not fail to be a very profitable one. Instead of importing year by year enormous quantities of jams and bottled fruits, India ought in reality to become an exporter of such things, Even now, some of the jams made by natives at Simla and other hill stations, are very far superior to much of what is imported from England. Excellent liqueurs can be prepared also from peaches, apricots and cherries grown on the Himalaya.

There are many other localities on the Himalaya besides Kulu where fruit culture and fruit preserves might be undertaken with profit. The most important existing fruit orchards are those at Mahasu near Simla, which were started about eleven years ago. To Mr A. O. Hume and Sir Edward Buck their existence and continuous development are due, and they are now in a flourishing condition under the control of the Simla Municipality. These and the Government Gardens at Mussoorie and a few nurseries under the charge of the Forest Department, are the only establishments where any results are periodically made known, and very few of these reports come under the eye of the general public. Excellent fruit is grown in many private gardens in British Garhwal and Kumaon. There are Government nurseries near Ranikhet, and the fruit gardens at Julna near Almora, have long been famous for the excellent quality of the fruit produced there by Messrs. Wheeler Brothers. We have not mentioned Kashmir, which country alone might in time be made capable of supplying the whole of India with fruit. But in order to render fruit culture on the hills more attractive as an industry for private enterprise, co-operation is required, and this would undoubtedly be brought about by the existence of a journal which might be started so as to include the whole subject of fruit culture and fruit preserving, in the plains as well as on the hills. Such a periodical would serve as a continuous record of results, as well as a medium for profitable discussion. By way of summary it may be stated: firstly, that the present condition of fruit culture on the Himalaya gives promise of great future development. Secondly, that persons, either individually or as a company, desiring to take it up as an industry, would not fail to find it a profitable undertaking by combining with that business the manufacture of jams and other preparations of preserved fruit. Thirdly, that in order to excite interest in the subject, and to induce competent persons to take up the industry as a means of livelihood, the starting of a periodical journal is a desideratum.—(*Pioneer, December 12th, 1894.*)

Lopping Tree Branches.

The question whether the owner of an estate has the right to lop the branches of trees growing on his neighbour's property but extending over his own, has just been settled in the decision in the case of 'Lemmon *vs* Webb' which we quote.

"This was an appeal before the Lord Chancellor, Lord Mac-
'naughten, and Lord Davey from a decision of the Court of Appeal,
'reversing a judgment of Mr. Justice Kekewich, who decided in
'favour of the present appellant. In 1869 the appellant purchased
'a property called Malquoits, situated near Guildford, in the county
'of Surrey, and comprising about twenty-one acres, and in 1879 he

'purchased another estate, called Ewhurst Place, of about 106 'acres, the boundaries of which marched with those of Malquoits. In '1878 the appellant sold Malquoits to the respondent. At the time 'of the purchase by the respondent of the latter property, there were 'growing on the boundary of the two estates, but upon the land 'of Ewhurst Place, a number of large timber trees, the branches 'of which overhung the land and soil of Malquoits. The respon- 'dent, without giving any notice to the appellant, after he took 'possession of Malquoits, proceeded to lop off the branches of the 'trees that overhung his land, whereupon the appellant instituted 'the present proceedings with the object of obtaining a declaration 'that the respondent was not entitled to cut any branches of the 'appellant's trees which overhung the respondent's land when such 'overhanging had continued for many years, for an injunction to 'restrain the respondent from cutting the branches, and for dama- 'ges. The action was heard before Mr. Justice Kekewich who 'ordered the respondent to pay the appellant the sum of £5 'damages and costs. The respondent having appealed, the Court of 'Appeal reversed the decision of Mr. Justice Kekewich, and gave 'judgment for the respondent. The appellant now sought to have 'the decision of the Court of appeal reversed, contending that notice 'was necessary before the branches could be cut.

'At the conclusion of the arguments for the appellant, their 'Lordships dismissed the appeal, being of opinion that the respon- 'dent was not bound to give notice before abating the nuisance.

'Appeal dismissed with costs."

The Deterioration of Scotch Pine.

It cannot to doubted that the question, "Has Scotch pine deteriorated in quality during late years?" requires still further elucidation. It is asserted in the Scottish Arboricultural Society's *Transactions* that subsoil has a good deal to do with the degenerate appearance of some Scotch pine plantations, and two cases are cited in support of this theory. Before accepting this, however, it might be advisable to investigate still further into the nature of the tree itself, also somewhat into the history of its cultivation in Scotland. In my estimation, no tree at present in cultivation is so accommodating as to soil and situation as the native Scotch pine. Provided the ground is drained, it will produce timber of the very best quality and dimensions on stiff, clayey soil. I have seen it luxuriating equally well on a sandy soil and subsoil, and on a tenacious bottom. Take, for instance, the light, sandy soil of Morayshire, where you can see a large extent of Scotch fir growing well, and on the other hand the tenacious clay of East Lothian, comprised in that belt of land intersecting the county from east to west—say from the village of Garvald to that of Pencaitland,

where there are some fine Scotch fir growing. The timber, age considered, cannot be surpassed for weight and redness of quality, and growing too, on a soil which taxes the genius of the very best farmer to work in certain seasons. With regard to Scotch pine assuming a coarse, naked habit at certain stages of their growth, may this not arise from the presence of too much moisture in the subsoil and not from any fault in the soil itself? I have seen, particularly after a severe thinning on damp soil of this description, the Scotch fir assume a weakly, straggling habit, and never regain its wonted vigour. The Scotch fir has a decided tendency to run to branches when allowed space, and that, too, on the very lightest soils; one of the most notable examples falling under my own observation was a plantation near the river Spey. Part of it for some purpose or other had got a very severe thinning at one time; the remains of large half-decayed branches pointing out in all directions from the stems bore ample testimony that the growth at one time had taken a lateral direction, and it was only after nature had time to partially work a cure that the plantation was beginning to start away with a vigorous upward growth. The native pine adapts itself readily to any climatic influence; if planted at a great altitude and on an exposed situation, it lives to a great age, and remains perfectly healthy, though only arriving at a mere bush. In the same publication, it is said that "the native Scots pine when planted in the south does not succeed well, except occasionally in moorish localities." I could point out some very fine Scots fir in the south of Scotland, and when it gets leave to mature, arrives at first-rate dimensions, but this part of the country has been long opened up to trade, hence the timber as a rule is much earlier cut. I am led to believe, however, that *Pinus sylvestris horizontalis* had a much wider geographical range in Scotland at one time than it has at present. There can be no doubt but that large tracts of it existed at a much earlier period in the south of Scotland. Where did the supply of timber come from that built such towns as Edinburgh and Leith previous to the beginning of sixteenth century—for it must be borne in mind that prior to that date they were largely built of wod? There are houses still standing supposed to have been built about that time, and wooded with Scotch fir; indeed, if I mistake not, Holyrood palace, which has been re-roofed, was formerly timbered with Scotch fir, which had been obtained somewhere in the neighbourhood, having stood for upwards of two hundred years. Now, since the north of Scotland has been opened up the same as the south, and where the process of clearing is being carried on to a large extent, the seed of the true variety will every year become more difficult to get, and Scotch fir may ultimately in many cases decline in quality in the north as it has done in the south. The selection of seed is everything in this question. In the south, where this has been carefully attended to, the reward has been

ample. The complete success of many fine Scotch fir woods in the south of Scotland can be traced in the first instance to the care bestowed upon selecting the true variety, which can only be secured in any quantity, from the natural forests in the north.

It might not be out of place here to mention that there is such a thing in forest nosology as the "larch disease"; the disease is clearly traceable to the effects of our climate upon this foreign plant. It is exactly the case with the Continental also Scotch fir; it is not suited to our climate and can never be compared with the native, the one which Nature has, with her own unerring hand, planted as the tree of the country. Some of the foreign Scotch fir, however, is not so unsuitable as others, but the best of it should be rejected unless for planting on dry, sheltered ground. Having had some experience of its early treatment in a small way (there being a home nursery of two acres under the writer's charge), I would reject it for no other reason than the percentage of deaths which occur in the nursery if the season is wet. A great amount of this seed is imported every year: it is a regular trade. I could buy it at Hamburg by the ton at a tremendous reduction compared with our own. I believe that the importation of seed is the chief cause of the languid, degenerate, appearance of many Scotch firs. In plantations of 20 and 30 years of age it could be distinguished this winter at a considerable distance growing along with the native pine, with the seed of which it had been mixed, by its brownish tinge and straggling head. The Continental Scotch fir does not succeed either at a high altitude; indeed, I think in its native habit it does not reach to anything like the same high range as our own. The true native Scots pine is the safest tree to plant—it is the tree of the country—it is exempt from all climatic influences or diseases. It has been said that Scotch fir will succeed on any kind of soil, and in spite of all the cry about soil, subsoil, and climate, I have seen nothing yet to refute this statement.—(*W. W. R. in Timber Trades Journal.*)

Afforestation in England.

In the interesting letter which we published yesterday, Mr. W. R. Fisher, of the Royal Indian Engineering College at Cooper's-hil., called attention, not for the first time, to the importance of the subject of afforestation. Our readers may remember that this question was ventilated in our columns last winter, and on the strength of the information that reached us, we asked the Government to make inquiry as to the best means of developing a great and neglected source of national wealth and a highly important industry. Nothing, however, has been done so far as we are aware, either by the Commissioner of Woods and Forests or by the Board

of Agriculture, in the way of collecting data or conducting experiments. We may be excused, therefore, for returning to the subject, and for urging once more the vital importance of a national plan of forestry. What are the facts of the case? Dr. Schlich, the eminent forestry expert, estimates that half the waste lands in the United Kingdom could be profitably laid down as forest land. There are 26,000,000 acres of these waste lands, and if we were to plant only 6,000,000 acres we should obtain, according to Dr. Schlich, in the course of time, a sufficient supply to replace our annual import of timber. But not only do we refuse to plant fresh tracts of woodland; we are allowing our national forests to deteriorate year by year; private forest lands are treated on no scientific plan, but their fate is decided for the most part by the exigencies of the landlord's pocket.

As to the profitableness of planting our waste lands, the experts are agreed. Care would have to be exercised in selecting the species for the various soils and situations, and trained foresters would, of course, be required to look after the trees In forty years' time, however, the return upon the outlay would be a handsome one. Mr. Fisher tells us that large plantations in Wales produce £90 per acre in the course of fifty-six years. In the interview which appeared in our columns last December, Dr. Schlich said, "I have calculated that a return may be obtained from all kinds of land, and it comes out, reckoning every possible outlay and including compound interest on the money invested, at the rate of about two and three-quarters per cent profit. As for the nature of the land which can be rendered profitable by afforestation, almost any kind is useful which can be obtained for £10 an acre, and that is always worth putting down in Scotch fir" Obviously, then, the State would stand to lose nothing by taking in hand the waste places and the unprofitable tracts of country, which might as well be at the bottom of the sea for all the good they do. Great Britain is, indeed, the only civilised country where it appears to be necessary to argue this point. In India, the Government have a fully-equipped forestry department. The French have a great school of forestry at Nancy, and Germany and most other European countries have their own forestry schools. Nay, our own Legislature is favourable to the principle while it remains indifferent to its application; for in 1887 a Select Committee of the House of Commons, presided over, if we remember aright, by Sir John Lubbock, recommended the establishment of a Forestry Board and national school in England. These schools might, perhaps, count for little in themselves but foreign Governments are by no means indifferent to the practice as well as the theory of forestry. The planting of the Landes, which was begun in 1789, has covered the vast desert of sand between the Adour and the Gironde with magnificent pine forests, and added £40,000,000 to the wealth of France. And this splended piece of reclamation, though the

greatest work of the kind, is only one of the many instances in which—to our shame be it said—other Governments have shown themselves superior to ours conserving and developing the national possessions. In spite of our taste for political economy and the gospel of thrift, we somehow manage to run through our national capital without much regard to the needs of the future. The time has come, we venture to think, to cry "stand" to this passion for turning everything realisable into ready money when the greed of commerce or the fancy for possession clash with the sound principles of public trusteeship. And in no respect is this more true than in this matter of afforestation.

We cannot imagine a better opportunity than the present for the inception of a scheme of afforestation worthy of this great and wealthy State. It is not necessary that all our enterprise and bravery should be spent abroad, or that capital should rust in the banks for want of enough Indian railways and African companies to absorb it. Here, at home, is a splendid opening for enterprise, administrative ability, and money that is going a-begging. Landlords are searching eagerly for persons to buy their lands on almost any terms; agriculture, it is asserted, is in the sorest straits, dying for want of enterprise and backing, and unable to afford more than the barest living to the manual workers; the villages have just received their charter of Government, but the villagers want bread and houses, and some sort of prospect if they are to use it; and in the great towns every winter throws multitudes of people out of employment, whilst the exacting and unhealthy conditions of life press more and more heavily on the masses of the people. If the statesmanship of Great Britain is not equal to turning such a situation to worthy purposes, if it prefers to follow the old fatalism wherever it leads, there is nothing more to be said for the present, except that we must grow new statesmen as fast as possible who can interpret the needs of the country. But we refuse to believe anything of the kind. The workers are waiting and pleading to begin. The pioneer work of afforestment can be undertaken without any special training; a town labourer can do it as well as a countryman with the slightest practice; it can be done in winter, except when the ground is freezing, as well as in summer; and year by year as the underwood grows and the saplings shoot up, the new industry will call for more labour, while it sends its fresh currents of sap through the old country. No doubt there will be initial difficulties to get over, as there are in every untried scheme. But there are difficulties in the present situation too. The process of transforming rural England into a cover for game is not without its difficulties. The congestion of misery, sickness, and lack of employment in the great towns is a standing difficulty. The payment of poor rates and the administration of a Poor-law on the cul-de-sac pattern is a difficulty. We ask the Government, therefore, with confidence, to take up this

question, and to deal with it in no mean or peddling way. Let them decide to cloth the bare places where thistles and weeds are growing, the grimy tracts of the black country and the wide moorlands, with the green trees which should be the heritage of every country, the trees which Mr. Auberon Herbert reminds us are as necessary to the beauty as they are to the proper utility of the country. Let them put spades into the hands of the workless labourers in town and country, and send them forth to plant the lands which have been stripped of their forests, and so help to bring back something of the old surroundings and the old spirit of the times when our land was known as Merrie England. *Daily Chronicle, 27th December*, 1894.

VII. TIMBER & PRODUCE TRADE.

Statement of average selling rates of timber and bamboos in Meerut, Cawnpore, Bulandshahr, Bareilly, and Moradabad for the quarter ending 31st December, 1894.

Description.	Timber Scantlings per score.		Bamboos per 100 scores.		Remarks.
	From.	To	From	To	
MEERUT.	R. A. P.	R. A. P.	R. A. P.	R. A. P.	
Sal 10′ Tors (Poles) ...	10 0 0	20 0 0	.	.	
Sal & Sain, &c., Kuries, 12 × 5″ × 4″ ..	25 0 0	40 0 0	..	...	
Sal bed posts, 7 × 2½″ × 2½″ ..	12 8 0	15 0 0	...		
Bamboos 9′ to 10′ per 100 scores ...	.	.	35 0 0	100 0 0	
CAWNPORE.					
Sal 10′ Tors (Poles) ...	4 8 0	5 4 0	.	...	
Sal, & Sain, &c., Kuries, 12′ × 5″ × 4″ .	20 0 0	60 0 0	..		
Sal bed posts 7′ × 2½″ × 2½″ .	10 0 0	12 8 0	..	...	
Bamboos of 9′ to 10′ per 100 score ...	...	..	30 0 0	60 0 0	
BULANDSHAHR.					
Sal 10′ Tors (Poles) .	.	..			
Sal and Sain, &c., Kuries, 12 × 5″ × 4″ ..	..		...	...	
Sal bed posts, 7′ × 2½″ × 2½″ .	..	.	...	...	
Bamboos of 9′ to 10′ per 100 score ...	..	.	50 0 0	55 0 0	
BAREILLY.					
Sal 10′ Tors (Poles) ...		10 0 0	.	.	
Sal & Sain, &c., Kuries, 12′ × 5″ × 4″	5 0 0 25 0 0 40 0 0	35 0 0 50 0 0 60 0 0	.	.. . .	
Sal bed posts 7′ × 2½″ × 2½″ ..		15 0 0	.	...	
Bamboos of 9′ to 10′ per 100 score ...	10 0 0	.	50 0 0	137 0 0	
	...				
MORADABAD.					
Sal 10′ Tors (Poles) ..	20 0 0	25 0 0	...	..	
Sal & Sain, &c., Kuries 12′ × 5″ × 4″ ...	30 0 0	50 0 0	..	...	
Sal bed posts 7′ × 2½ ″ × 2½″ ...	0 8 0	0 10 0	...	...	
Bamboos of 9′ to 10′ per 100 score ...	...	..	50 0 0	75 0 0	

Churchill and Sim's Circular.

December 6th, 1894.

MAHOGANY-MALABAR.—Several small parcels, which had been held as unsaleable for upwards of two years, were cleared by unreserved auction at the end of the year. The disastrous prices realized, averaging barely 1¾d. per foot, furnish very forcible evidence to shippers that this wood is not appreciated here.

CEDAR.– Only one small parcel came from Malabar, but the logs, being large, brought fair prices, and it is only sound, straight logs, of large sizes, which are likely to sell well.

PADOUK.—The consumption of this wood has not extended so much as was anticipated, the demand for the United States seriously declined, and the probability of increased use in the home trade was prevented by the low prices ruling for Mahogany. These circumstances resulted in an accumulation of stock, which is now heavy, and a decline in prices to from 2s.6d. to 3s. per foot cube for planks and logs.

ROSEWOOD.—East India. Old stocks are gradually cleared, but at low prices, which showed that no improvement all through the year. Only two small parcels arrived, and these having been placed, importers are now without stock ; but shipments should be small and consist solely of large, sound logs of good colour. Quotations are from £5 to £8 per ton.

SATINWOOD.—Figury logs brought good prices, but there was very little demand for plain wood, only three small parcels (together 31 logs) were imported, no planks or boards came forward, but they were not needed. Quotations for logs are from 6d. to 12d. per foot.

EBONY—East India. Only two small parcels came forward, and these being above average in colour and soundness, sold well ; there is now no stock on hand, so that moderate shipments of really good lots would find ready buyers. Quotations are from £6 to £8 per ton.

EAST INDIAN TEAK -The importation of timber and planks has been :—

	1888.	1889.	1890.	1891.
	12,270 loads.	19,407 loads.	16,000 loads.	16,586 loads.
and the deliveries	16,618 ,,	15,899 ,,	17,140 ,,	14,371 ,,
		1892.	1893.	1894.
		7,923 loads.	12,687 loads.	9,849 loads.
and the deliveries		10,455 ,,	12,646 ,,	10,620 ,,

There is nothing satisfactory to report of the London Market for Teak during 1894, this finest of woods having remained at low and very stagnant level of price from one end of the year to the other, and even this cheapness having failed to check a very decided falling off in the rate of consumption. The market stock has been kept low all the year by a judicious moderation in the shipments both from Burman and Siam; the latter continue to grow in favour as the excellence of their quality and conversion becomes more practically known.

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The Reproduction of High Forest.—(*Cont.*)

(By M. Ch. Broillard in the Revue des Eaux et Forêts.)

As to the arrangement of the coupes by area in a forest treated on the uniform system of successive regeneration fellings, it is obvious that in the case of a compartment in which each coupe passes over the whole area that the case is met by returning simply at intervals of five years. It is also clear that if we were dealing with five similar compartments, a coupe could be made each year, one in each of the five compartments successively, until the exploitation of the whole was compete, *viz.*, for 20 years.

As to whether the yield of these coupes would be more or less equal would depend on circumstances, but it is easy to see that in any case *a good coupe* would be made every year ; in the 19th just as in the 6th or the 15th, or any other year. The relation of the values of the *different coupes depends not only on the number of* trees but also on their value. The second coupe would, of course, give less trees than the first, and so with the others, each would give less than the preceding one. But if in each successive coupe the worst trees are chosen, it is possible that the values would equalize themselves, sometimes even the value increases. For the present I restrict myself to stating this fact.

At the end of 20 years then, the exploitation of the five compartments will be complete, just in the same way as one would complete the exploitation of a small coppice working circle. But if we have 20 high forest compartments, we can, after exploiting the first five in 20 years, set aside five others for the next 20 years, and so on, taking 80 years to finish the whole, and similarly 100 years in the case of 25 compartments, or 120 years for 30, making each year a good coupe, good in a sylvicultural sense, and attended with valuable results on the crop.

This then is a simple method of fixing by means of a small number of equal coupes the working by area of a forest treated on the uniform system of successive regeneration fellings, for it is always easy to divide it like a coppice into 20 or 30 compartments. This too fulfils the promise I made some two months ago to indicate the best method of removing each year approximately the 20th or 30th part of the material of a high forest crop.

There are several other methods of adapting the working to different forests. I mentioned one in the "Traitement des Bois," p. 258, which is as follows:—If it is desired to exploit two principal coupes each year instead of one, this can be done by making the number of compartments equal to one-half the number of years in the rotation.

In the forest of Darney, worked on a rotation of 160 years, each working circle is divided into 80 equal compartments. By locating the first felling successively in each compartment in the odd years 1895-97-99, &c., and the second felling in the same compartments in the even years 1900, 1902, &c., the working plan is complete. The third felling follows the first 10 years after in 1905, 1907, &c., and the fourth similarly follows the second in 1910, 1912, &c. From the tenth year two coupes are thus regularly exploited each year, 1st and 3rd, or 2nd and 4th. The coupes like the compartments thus go in pairs, which seems an excellent and simple arrangement. The order of the felling is easily seen from the following table showing the arrangement of the coupes in pairs:

Year of the felling.	1st and 3rd fellings.		2nd and 4th fellings.	
	Compartment.		Compartment.	
1895	I	..	..	
6	...	.	.	.
7	II	...	.	..
8	...	...	..	.
9	III	.	...	.
1900	IV	...	I	..
1	...	...	II	.
2	V	..	.	.
3	.	.	III	..
4	VI	..	...	...
5	...	I	IV	...
6	VII	II	.	.
7	...	...	V	...
8	VIII	III	..	.
9	...	...	VI	I
10	IX	IV	.	.
11	.	.	VII	II
12	X	V	..	..
13	..	..	VIII	III
14	XI	VI	..	..
15	..	..	IX	IV
16	XII	VII	..	..
17	..	..	X	V
18	XIII	VII	..	..
19	..	..	XI	VI
1920	XIV	IX	..	..
21	..	..	XII	VII
22	XV	X	..	..
23	..	..	XIII	VIII
24	XVI	XI	.	...
25				

The blanks left where no fellings are provided for the first few years will often be filled by compartments which are in course of exploitation, and the table will thus be complete and the yield sufficient from the commencement. The typical arrangement of the coupes in a High Forest would be that in which the forest is divided into the same number of compartments as years are required to produce an exploitable crop, and which provides each year a 1st, a 2nd, a 3rd and a 4th felling, each passing from one compartment to the following one. The fellings following each other at 5 or 6 years' interval in the same compartment, it is as easy to regulate them as it is thinnings. One may almost say there is nothing to anticipate, once the exploitations are started one simply has to follow the order. This ideal is sufficiently easy to realize in the high forests of the plains of France. Leaving this ideal we are well aware that it may be necessary to return a fifth time in several compartments to remove some of the trees reserved in the fourth coupe which would otherwise deteriorate. Again, it may happen that occasionally one of the four principal coupes has to be reduced in a given compartment, or even postponed altogether, on account of the insufficiency of the reproduction, or for some other reason. The sequence of the fellings undergoes from then a delay of five years in that particular compartment, but the general order is not affected. The record of such facts, together with the number and volume of the trees exploited from each compartment at different times, will form the history of the compartment, each of which thus becomes an experimental plot. In the course of time it will be easy to follow the events of the past, and the phenomena peculiar to the forest and the different parts of the forest will manifest themselves as time goes on. The record thus kept up, as has been done since 1881 for the Forêt de Haye, will show by simple and numerous facts what has been the production of the soil, what system of culture is suitable, and what modifications it may be necessary for the working plan to provide. These will probably be just as simple as the main provisions.

If working by area is easily applied to high forest of leafy species and pines, it is equally adaptable to silver fir forests, and particularly so when beech, spruce, Scots pine or other species are mixed in the crop. Sometimes one is at a loss to know how to set about obtaining a satisfactory reproduction in such forests without exposing the whole tract to the ravages of storms.

Generally, the system which offers the best chances of success will be that which provides for the removal every six years of one silver fir in five, one beech or spruce in three, and one pine or other species in two, in the same way as one would remove one oak in four if the oak were represented. Suppose, for example, that there were 300 trees per hectare, 100 silver fir, 100 beech and

100 Scots pine, the first coupe would remove—

Silver fir, 1 in 5, the least promising	... 20
Beech, 1 in 3, the most spreading	... 33
Pine, 1 in 2, those with the smallest crown	... 50

There would then remain 80 silver fir, the best; 67 beech, the straightest, least spreading; and 50 pines, those with the best crowns, all characters valuable in themselves as well as for the production of seed.

Six years later the next coupe would remove 16 silver fir, 22 beech and 25 pines, chosen as in the preceding operation. The third coupe would remove 13 silver fir, 15 beech, and 13 pines, and finally the fourth 10 silver fir, 10 beech and 6 pines.

There will thus remain finally some 40 young silver fir, 20 small beech, and some half dozen well grown pines, to enrich the new crop, with which all or most of these will be able to assimilate themselves. If not, a fifth coupe would dispose of such trees as were likely to deteriorate. This would be 24 years after the seed felling; it is not too late, as in mountainous regions it requires a fairly long time for the regeneration of a forest of mixed species to complete itself.

In a mixed crop of spruce and silver fir, the exploitation may be conducted without any particular modification. It will probably be desirable to remove one spruce in three, in order to fell proportionally more spruce than silver fir. In pure forests of spruce and forests of beech and spruce, I think that this would still be the figure to adopt, on account of the large number of stems and the robust nature of the young spruce seedling, at any rate where the method of thinnings is applicable to this species. In all that has been said above, there is nothing which refers to the selection method, nor is any comparison intended of the two methods; indeed the result of such comparison is usually a discussion based on uncertain premises, and the more preferable of the two systems, selection or thinnings, seems to depend on which is better applied.

Whatever the facts may be on this point there is no doubt that the regeneration of a high forest as a whole may be obtained in the best condition by means of coupes fixed by area, and returning over the same ground at fixed intervals.

In proceeding as I have just indicated it is possible to satisfy all the conditions required by the different species and by given or desired mixtures of species; it is easy enough to satisfy oneself on this head, when the character and reproductive power of the different forest species is known, by calculating the number of trees of each species left standing after the 1st, 2nd, 3rd, and 4th coupe.

Whether the trees of a crop are large or small, or of various sizes mixed together, the definition of the regeneration felling by area remains the same; it is always the removal of one tree or one

pole in 2, 3, 4, or 5, according to species. From a group of five large silver firs only one would be taken, if there were fifteen small ones, either in a group or already more or less separated, then three would be felled; if there were large and small mixed together one in each five would still be removed, and that one the least promising, whether among the small or the large trees.

Take the most complex circumstances: for example, a high forest or a coppice with standards, or even an old simple coppice, in which the crop is complete in places, incomplete in others, open in others, having here and there only isolated trees, in short presenting all sorts of conditions not only in the above respect but also as regards the species. The most practised of Forest officers might be at a loss to know how to conduct a regeneration felling in such a case, as it would have to be of a quite different character from point to point. It is only recently I had occasion to prove this on the spot in a coppice undergoing conversion, where, above all, it is important to have some certain and definite method of procedure. In seed fellings or secondary fellings it is easy enough to test the fact that in following the method indicated above, a suitable coupe will in all cases be made, and one which will tend to bring about at all points the desired result, which is the re-stocking of the soil with the principal forest species. It is certainly better to choose the trees to be felled carefully, in removing by preference among the oaks the worst tree, among the beeches the most spreading, of the hornbeam the shortest, and so on, instead of simply taking the fourth oak, the third beech, without discrimination throughout the compartment. But if I am not mistaken, in undertaking the work even in such a mechanical manner as this, one would, nevertheless, succeed in time in obtaining a good reproduction of the forest. With intervals of five years between two successive coupes this time may be 15, 20, or 25, years according to the skill of the operator; and the question as to whether it is preferable to finish in 15 or in 25 years is not easily answered. One point about which there is no doubt is the necessity of the free use of the bill-book at the time of each exploitation, to clear the ground, cut back the beech, or thin out any inferior species which threatens to invade the crop, according to circumstances. For such an operation I do not see that there can be any other guide but experience.

The method indicated to be followed does not then render unnecessary the careful choice of the trees to be felled, a thorough knowledge of the forest, nor the precautions to be taken to prepare the soil or get rid of the undergrowth completely or partially, as the case may be, any more than it suffices to assure the production of seedlings of the better species where seed bearers of these are absent. There can be no doubt that to manage and work a forest it is desirable to have a Forest Officer, but before commencing operations, he, no matter how experienced he may be, should have a clear idea of the nature of the coupe he is going to make, which

is not by any means always the case. The mechanism described above limits and defines the idea of the operation from a cultural point of view, while at the same time it fixes its limits on the ground. Moreover, owing to the exploitations being fixed beforehand, *and returning at fixed intervals to the same areas, it is* possible to undertake sowing, planting, or other necessary works at the proper time and under the most favourable conditions for the assurance of their maintenance and success. It has also the merit of eliminating from a high forest the clear felling which is the expedient of an ignorance always to be regretted, and the final felling, which is an operation contrary to nature. Then it adapts itself in a special manner to each forest, showing clearly the result of the successive exploitations fixed by area. The irregularity and disorder of coupes by volume would never give this information.

A. F. G.

Wood for Tea-boxes.

The following additional information about tea-box woods in Assam may prove of interest. Besides the woods mentioned in the October number of the the "Forester," a large quantity of "shooks" are imported from Japan; they belong to some coniferous wood, probably *Cryptomeria Japonica*, and though they cost rather more than Simul at the outset, nevertheless as they are thoroughly seasoned and ready for dove-tailing, they can all be utilized without any loss.

Consignments of what is known in the trade as 'spruce' are received from Vancouver's island, and some red wood, probably a kind of *Dipterocarpus*, comes from Burma.

At first sight it may seem strange that, with her large *forest* area, Assam should have to indent for the tea-box woods from distant countries, but it is essential among other conditions, that for a wood to come into practical use on a large scale, the tree which yields it must be gregarious; it will never pay to employ a wood which is only found scattered here and there. Thus, though there are in the Debra Dun forests several trees adapted for tea-boxes, it is probable that the planters of that district will eventually use either spruce or silver fir from the neighbouring Himalayan forests, as soon as their available supply of mango trees has been exhausted.

A. S.

Raising Box from Seed.

Box (*Buxus sempervirens*) is of course one of the valuable trees of the Himalayas. It grows in several localities in the Punjab, and ascends sometimes to a height of 8,000 feet.

In Bashahr the tree is found along the Nogli, the Ganwi, the Wangar, the Panwi and the Punang rivers. It extends to the vicinity of the dry zone above Wangtoo, but disappears at Sholtu. Like other trees of the moist zone it rises higher as the dry zone of climate is approached, for the obvious reason that the rainfall at high elevations is often great and very frequent, and heavy mists remain long over such areas during the monsoon months. Very fine specimens of box are still found in the much exploited forests situated in the basin of the Nogli river in the moist and sheltered localities along the banks of streamlets, generally in company with chestnut, maple, hazel, walnut, yew, ash and spruce. Here most of the trees attain a girth of 4 feet, and sometimes grow clean boles four times their girth in height. All these forests were felled over some time in 1885, when a large quantity of this timber was carried to Simla, but owing to the fall in prices it could not be profitably sold.

Natural reproduction in these forests was fairly satisfactory. It was therefore attempted to raise the tree artificially. For this purpose several nurseries were established in the most favourable sites. I remember I made a large nursery at Dankali in 1883. But all these nurseries are still as bare as the palm of the hand. I also believe that about that time experiments with regard to artificial reproduction of the tree were instituted in other divisions in the Punjab as well. But all efforts to produce the tree in a nursery have hitherto resulted in failure. A few days ago I visited a Box forest on the Nogli. A Zemindar of an adjacent hamlet, who had collected Box seed in October-November 1893, had left some capsules in a corner of a field. A dense crop of seedlings had come up there. On a careful examination I found that the seed which lay sheltered inside the fruit had all germinated, while the black grains which lay without the capsules, exposed to frost, had all of them *got rotten*. *The sine qua non* for the germination of Box seed is therefore shelter from frost. The Box seed is not very oily. This fact renders its wintering a matter of some difficulty. It is for this very reason that the natural Box seedlings generally come up from under rocks or spring up on similarly sheltered places where frosts cannot destroy the vitality of the seed. In order, therefore, to raise the seedlings in a nursery on the Nogli, I would recommend that the entire capsules, when well ripe, should be sown, and I should not wonder if the seed sown in the rains—in the first week of July—would freely germinate.

BASHAHR:
10th Febraury, 1895 } MIAN MOTI SINGH.

The Flowering of the Thorny Bamboo.

Mr. Bourdillon's account of the Travancore teak is excellent. I wonder, however, that he did not note how much the shorter grained teak of the hills used to be preferred to the teak of the deep soiled valleys in the old Bombay dockyard, especially for "knees" and keels in ship-building, where great strength was required. Will you turn to page 468 where his remarks on my old friend "Bambusa arundinacea" are given. "It dies down at intervals of from 25 to 30 years, and 8 or 10 years must elapse before full sized culms can be obtained." Mr. Bourdillon continues: "A general seeding occurred in South Travancore when 'Lieut. Ward was travelling through the country, and another in '1870. This last was confined to the area south of the Acchankovil 'river. North of this river the seeding occurred about 1879-80, 'and it has been impossible to get full sized bamboos in North Tra-'vancore ever since." From these observations I infer two things, both contrary to Mr. Bourdillon's initial theory. First, I infer that in South Travancore there was no general seeding between 1817 and 1870. Secondly, that more than 13 years are required for the seedling to develope and yield marketable mature culms.

At the special invitation of the Editor of the *Journal of the Bombay Natural History Society*, I roughly threw together my observations and the result of my readings on this subject. You will find my contribution at page 298, of Vol. VIII, No. 2, published on 15th October 1893.

Very few, if any, Europeans stay long enough in this country to witness a second general seeding on the same area, and of those few, probably hardly one would be an observer of Nature. I asked what hope there was of solving the question of the life period of the bamboo by native evidence. "Trustworthy evidence is not forth-'coming. It is in the hope that others, while pardoning my mistakes, 'will help to solve this puzzle, that I venture to indicate direc-'tions in which further enquiry promises." I believe I brought together all the evidence then available to me. You may care to read it, so I copy it from the pages of the Journal. You will see that Mr. Bourdillon's facts, but not his theory, agree with the general native belief which, in 1893, I adopted. You will, no doubt, be struck by the coincidence of the flowering in South Travancore and Jubbulpore in 1869-70, and of that in North Travancore in 1879-80, very nearly or quite simultaneously with isolated clumps at Nagpur, Narsinghpur, the residue of those left in Sleeman's Park at Jubbulpore, and shortly before the second known general seeding at Dehra Doon. So also, Lieut Ward's observation in South Travancore in 1817 coincides with the alleged flowering in the Weinganga valley when Appa Sahib Bhonsla lost his throne. But in the Weinganga country I think the next flowering was in 1866, just before the Jubbulpore exhibition:—

'My first recollection of the Katang bamboo is derived from 'Jubbulpore when Sleeman's Park was still the pride of the station. 'And the pride of the Park lay in the luxuriance of its bamboos. 'Next, at the Nagpore Exhibition at Christmas time, in 1865, 'the finest poles of the Balaghat District were shown. 'I can well remember their extraordinary length, but am too 'cautious to hazard figures. Anyone curious on this point had 'better hunt up an old catalogue of the Exhibition or apply to 'Colonel Bloomfield, an excellent authority on bamboos, who was 'the first Deputy Commissioner of the Balaghat District. The ex- 'treme length of those poles was accounted for in this way: the 'bamboo clumps grew on deep soil, in a moist valley, very close to 'one another; having no room for lateral expansion, they could 'live only by growing very tall."

'There were at that time, *viz.*, at the end of 1865, one or two 'enormous clumps of Katang in the Maharaj Bagh, the public 'garden at Nagpore, and on its outskirts a great number of young 'ones, all apparently of the same age not more than about ten 'years, possibly less.

'The Jubbulpore Exhibition was held at Christmas 1866. I 'believe there were no Balaghat bamboos exhibited there, and for 'this reason, that *meanwhile there had been a general flowering of* 'the Katang bamboos in the Upper Weinganga Valley, that is in 'the Bhandara and Balaghat districts. But on this point I have 'no personal knowledge; I have, at best, a faint recollection of what 'I heard long ago. It may be that the seeding in the Weinganga 'Valley did not occur till 1870. The rainfall of 1868 was a dis- 'astrous failure in the old Saugor and Nerbudda territories, and 'this, following on poor harvests in 1867 and the spring of 1868, 'severe famine ensued. In May of 1869 I was transferred from 'Nagpore to Jubbulpore. Passing Seoni, two or three miles of 'projected bamboo avenue were met. Small clusters of roots had 'been divided off from the parent clumps, and these roots, with 'four or five feet of stem, had been planted, fenced, and well water- 'ed. In Jubbulpore the rains of 1869 commenced very late, but 'were not particularly short in quantity. In the spring of 1870 'about four-fifths of the bamboos in Sleeman's Park and through- 'out the station burst into flower, seeded and died. The seed 'would have been all used as food but for the care of the District 'officers. Seed nurseries were formed, and a vast number of 'young plants were reared, and the surplus distributed far and 'wide.

'Early in 1881 I was a second time Deputy Commissioner of 'Narsinghpore, living in the house which had once been that of Sir 'William Sleeman, uncle of Colonel Sleeman, the last owner of 'the Park at Jubbulpore. In my compound stood two superb 'clumps of the *Bambusa arundinacea*. These burst into flower, 'seeded, and died in the hot weather of 1882. From their seed

'was raised a considerable supply of young trees, which were distri-
'buted in great part along the Great Indian Peninsula line of
'Railway. It was, to the best of my belief, in the same year that
'the remaining portion of the old clumps in Sleeman's Park at
'Jubbulpore and the old bamboos of the Maharaj Bagh at Nagpore
'seeded and died. Possibly I am wrong about the Nagpore
'Katangs. I remember that in or before 1879 the Forest De-
'partment, under the immediate care of Colonel Doveton, began to
'cultivate these bamboos at Telin Kerry, two miles west of Nagpur,
'for profit. The supply of Nagpore and Kamptee was aimed at.
'Possibly the seeds for this interesting experiment came from the
'old bamboos of the Maharaj Bagh.

'I learn that the general seeding of the Katang bamboos at
'Dehra, in the Doon, occurred in the spring of 1882. In the
'weather of 1885, I visited the upper valley of the (Cuttack)
'Mahanadi river, and the Jeypore Zamindari of Madras. Return-
'ing by the way of Dhamtari and of Rajim (where the Pairi river
'falls into the Mahanadi), I found a large number of bamboo
'clumps coming into seed. The Zemindars and Government
'officials promised to save all the spare seed for me, and this they
'kindly did. Two sacks of well-ripened seed reached me at Ghazi-
'pore, and thence it was distributed throughout India; some was sent
'to Australia, to Cyprus, to China, and even to Cornwall. The
'Secretary to the Agricultural and Horticultural Society of India
'took the rest for their corresponding Societies. He also kindly
'brought to my notice writings of Sir William Sleeman in the
'printed proceedings of some Society, possibly of the Asiatic
'Society, in which was noticed a general seeding of the Bamboos
'at Dehra Doon, in or about the years 1832. In 1886 I revisited
'Rajim to find that all the clumps had died off. Here and there
'was to be seen an exceptional stalk, and a few attenuated and al-
'most abortive shoots had sprung up from moribund roots. These
'were striving to flower and seed.

"This season I visited the Malkua hills, about thirty-five miles
'south-east of Rajim. Here also were dead clumps; around them
'young seedlings struggling for life, the outcome of the seeding
'of 1885. From several sources reports were heard that all the
'Katang bamboos in that mass of Vindhyan sand-stone hills, from
'amid which the Jonk river begins its northward course, had
'seeded in the previous year (1885). This mass of hills lies
'about thirty miles south-east of the Malkua hills, south of an
'imaginary village named as Tarnot on the Government maps of
'the Chhattisgarh Feudatory States.

'It was in this year (1886) that with a well known member of
'this Society (Natural History Society of Bombay), I saw the waters
'of the Udanti, a branch of the Tel, which again is an eastern affluent
'of the Mahanadi. The Udanti rises in the western side of
'the same mass of hills whence the Jonk runs northwards.

'The Udanti first runs southwards, then turns to the east. 'We had occasion to visit the favourite mud bath of an old 'solitary bull buffalo on the banks of the Udanti—not a dozen 'miles from its source. This spring was in the centre of a large 'thicket of Katang bamboo, said to have all grown from the seed 'of one isolated clump. I can only give a *guess* at the age of the 'young trees. My own re-considered impression is that the parent 'clump must have seeded after 1870, but before 1882. I hope the 'friend who put an end to the bull's career will be able to give 'a better estimate of the age of the young thicket.

'In 1878 I saw the beautiful bamboos of the Indore Residency. 'I know nothing of their history or pedigree, but imagine them 'to be of the same age as the young clumps I saw at Nagpore in 1865. 'In 1886 I saw a number of mature clumps at Gorukpore. These 'must now be very near the end of their life-period. In the spring 'of the current year, 1893, we had bamboo clumps flowering in 'the gardens of Queen's College at Benares and in the Civil Lines 'at Cawnpore. It is said (this is being verified) that the fine clumps 'at Dhariwal in the valley of the Ravee, near Gurdaspore in the 'Punjab, seeded last year.

'The building of Queen's College, Benares, dates from 1841–'1843. It does not follow that the gardens were laid out at the 'same time. Indeed it is believed that this was done by Mr. 'Griffiths. The present Principal, Mr. Wright, believes, on parole 'evidence or tradition, that the bamboos now seeding have been in 'the garden for forty-five years. But granting this, it does not 'follow that they are only forty-five years old. They may be older. 'They may have been transplanted forty-five years ago from a 'nursery, or they may have been then raised from roots partitioned 'off from a clump of some years' growth.

'Pass on to our native beliefs. First of all, to the *Bambusa* '*arundinacea* is attributed a life period of fifty to fifty-five years. 'Next, natives tell one that its seeding is not gregarious; on the 'contrary, that, however widely distributed may be the progeny 'or the offsets deriving from any one general seeding, all the pro-'geny and all the offsets must flower, seed, and die simultaneously. 'Thirdly, they profess to believe that a general seeding coincides 'with drought or with scarcity after drought. It has been asserted 'that coincident with such scarcity will be found an unusual abun-'dance of the edible seeds of forest trees, such as the Sal tree, '(*Shorea robusta*), of the Nimar Anjan (*Hardwickia binata*), or 'the common Shisham (*Dalbergia latifolia*) and the like—a pro-'vision of nature for such a time of want. To this it has been object-'ed that whereas coincidence attracts attention, the opposite condition 'passes unnoticed. This is a theoretical objection of no great weight. 'Beyond question the flowering of the common male bamboo 'is rightly described as gregarious. Its life period seems to be 'about fourteen years. On the same hills I have seen large patches 'seeding in different years in 1870 and again in 1879.

'In the year 1874 I passed through the Pandooah jungle 'between Maldah and Dinagepore, in Lower Bengal, on so-called 'famine duty. Returning in 1875 I found all the thick thorny 'bamboos of that large tract—a variety strongly resembling, but 'smaller than, the Katang—had lately seeded. The general seed-'ing at Jubbulpore in 1870 followed the Bundelkhand famine. 'I have heard mention of bamboos seeding at the time of the 'Madras famine, but cannot vouch for the accuracy of the inform-'ation. I know of no noteworthy scarcity following on drought 'in or previous to 1882, or 1885, or 1893. On the second topic 'of belief, all the evidence *I have to offer is this.* In Seoni 'strenuous efforts were made to raise an avenue by laying down 'offsets from old clumps taken from the nearest source of 'supply, the station of Jubbulpore and Sleeman's Park. I 'saw these full of promise in 1869. By the following May 'they had prematurely budded from the stem, and were withering 'away with their abortive seeds. Although there may be no more 'evidence available, it would be rash to reject this native theory. 'At any rate it is pretty, and is not disproved. I cannot now 'refer to Sir William Sleeman's writings, but I cannot resist a 'belief that some of the clumps in his park at Jubbulpore and 'those in his garden at Narsinghpore came from the seeding in the 'Doon, about which he wrote. That seeding was about 1832. 'Moreover, there was a general seeding in the Doon in 1882. 'This gives an interval or life period of fifty years. Some late 'inquiries in the Doon elicited the curious answer that between the 'consecutive flowerings of this bamboo a child will grow to be a man, '*and his son will reach manhood.* Nothing more definite could be 'learnt. Were I an interviewer, no doubt the words of a conversa-'tion of about 1879 in the Bhandara or Balaghat District would 'be forthcoming. Though they cannot be given, their substance 'is clearly remembered. Speaking of another old man my inform-'ant declared his friend to be old beyond computation a hundred 'years old or more. Well, if the Sahib was not content with that, 'surely it was enough to say that his friend had twice in his life-'time eaten the seed of the great bamboo. Gently pressed to try 'to merely fix the earlier time, *the old man at last gave a clear* 'clue to it. He had often heard his absent friend speak of having 'had to eat the seed of the Katang bamboo in the year when the 'Raja Appa Sahib Bhonsleh lost his kingdom. All the villages 'were burnt by the Gonds, who rose in rebellion for the king's sake, 'and but for the seeds and roots of the forest, people had died of 'hunger. There is no valid reason for disbelieving this unpremeditated 'story. It may then be concluded that there was a general seed-'ing in the Upper Weinganga Valley in 1818, and another 'between 1865 and 1870—an interval of some fifty years."—I am now writing from Najibabad, in the Bijnour district, not far away from Dehra Doon. Here we have most luxuri-ant and lovely growths of this bamboo. These assuredly have no

connection with the general seeding in the Doon of 1882. Probably the age of these Najibabad clumps is about twenty-five years. If I am right, they point to their seeding of 1869-70.

Mr. Bourdillon thinks that clumps will yield mature culms in ten years or less. My own belief, derived from experience, is that no clumps can be said to come fairly into bearing in less than fifteen years. You will be able, if you accept this opinion, to apply the analogy of other natural products of semi-tropical lands. What is ordinarily the proportionate space of immaturity, compared with the duration of a plant or of a tree's matured life? Freaks of nature we see in the individual, but regularity of operation is the first of Nature's laws.

NAJIBABAD:
8th January, 1895. } JASPER NICHOLLS.

A large Banyan* tree.

The following information with regard to the size attained by the Banyan tree in the sub-Himalayan tract of the North-West Provinces may be of interest to some of your readers. I had occasion to go through the waste lands of the village of Haidarpur Hinduwala, in the Saharanpur district, which adjoin the Government reserved forests on the southern slopes of the Siwaliks near Barkala, a place about 9 miles east of the Jumna where that river enters the plains of India. The waste lands referred to lie between the Eastern and Western branches of the Barkala *Rau*†. The Banyan tree stands near the Western edge of some scrub jungle which is much grazed over, and the trees of which are lopped annually to provide material for making hedges to keep cattle and wild animals out of the fields. It forms a very striking object from the outer spurs of the Siwaliks, where it stands out very definitely, from contrast, probably, to the poor scrubby trees by which it is surrounded.

The girth of the central stem, leaving out the aerial roots which have been thrown out near it, measured at breast height, is 27 feet 10 inches. There are in all 127 distinct aerial roots which vary in girth, measured at breast height, from 7 feet 1 inch to 7 inches. The height of the tree was measured with an Abney's level and a 100 feet chain, and was found to be 53 feet. Two diameters of the crown measured at right angles to each other, with a 100 feet chain were 183 feet and 150 feet respectively. The circumference of the crown measured with the same chain was found to be 523 feet. The foliage comes down very much nearer to the ground on the south than on the north side of the tree, and two strikingly distinct kinds of foliage are seen. On some branches the foliage consists of large shining green leaves, while on both sides of this portion of the crown the leaves are very much smaller and

* Ficus bengalensis *Linn.*—Vern. *Bar, Bargat.*
† Bed of a mountain torrent.

not nearly so shiny. The central part of the crown consists of large vigorous leaves, while the two sides of the crown are made up of much smaller and more greyish green leaves. The difference between the foliage of the different parts of the crown is so distinct that it must strike even the most casual observer. The tree is said to be 1,000 years old, and it may well be that age. The tree is still very vigorous, and shows no signs of decay, or old age, unless this be indicated by the smaller leaves on some parts of the crown.

BARKALA:
9th February, 1895

C. GILBERT ROGERS.

II—CORRESPONDENCE.

Bamboos and Famine.

SIR,

Now that the views and wishes of the Government of India have been so clearly expressed with regard to the management and development of the forests throughout a great part of Peninsular and Continental India—that is, excluding the densely wooded tracts of further India, form Assam down to Tenasserim,—I think it might prove of benefit if you could see your way to reproduce the opinions and advice of the late Mr. Sulpiz Kurz, as stated on pages 258 to 261 of Vol. I of the *Indian Forester* (No. 3. January 1876). As in all likelihood comparatively few Forest officers have ready access to the first volume, published nearly 20 years ago, it may perhaps be permissible and advisable to quote in full the passage I refer to, which is as follows :—

"From my own observations, and they extend over 20 years, 'I must concur with the general notion of natives that drought 'greatly encourages flowering, although a certain age, or say 'rather state of debility, seems quite requisite before this favour-'able influence can fully come into play. So, for example, I have 'observed in Burma pygmæan plants of Tinwa (*Cephalostachyum* '*pergracile*) of only about half to one foot in height, which had been 'continuously burnt down by jungle fires, and which flowered to-'gether with their unhurt companions of 30 to 40 ft. in height. But 'stragglers from seeds that germinated at a latter date (say the 'subsequent year) may also be seen occasionally amongst the 'patches of flowering bamboos without producing a single flower. 'In such cases we have to generalize upon the broad facts before 'us, and leave stray exceptions as interesting hints for the con-'sideration of casual phenomena. Both dry seasons that I spent 'in Burma were described to me as extraordinarily hot ones, such 'as the oldest people could not remember, and my harvest of 'flowering species of bamboo was remarkably large, so much so 'that I missed the flowers of few species only, and these were such 'kinds as grew in tropical forests or near water, and hence were 'not likely to be affected by drought. Never were so many species 'of bamboo in flower in the Calcutta Botanical Garden as in '1874, a year of drought and famine. Flowering of bamboo during 'time of famine is very usual, and there is a saying with the Indian 'that "when bamboos produce sustenance, we must look to heaven 'for food." The correctness of this proverb has been challenged, 'but I believe, upon very insufficient grounds, for although bamboo 'may and does flower and fruit in years when the most beautiful 'crops are harvested, it does not follow that there was no drought 'in that season. How important an event the general flowering 'is in time of famine may easily be gathered from a few facts. In '1812, in Orissa, a general flowering of bamboo took place, and

'prevented a famine. Hundreds of people were on the watch day 'and night in order to collect the seeds as they fell from the 'branches. Mr. Shaw Stewart, the Collector of Canara (Western 'coast of India) states, that in 1864 a similar event took place in 'the Soopa jungles, and that a very large number of persons, 'estimated at 50,000, came from the Dharwar and Belgaum dis- 'tricts to collect the seeds. Each party remained about 10 'to 14 days, taking away enough for their own consumption 'during the monsoon months as well as some for sale, and he 'adds that the flowering was a most providential benefit during 'the prevailing scarcity. Mr. Gray, writing from Maldah in 1866, 'says: 'In the south District, throughout the whole tract of 'country, the bamboo (probably *Bambusa Tulda*) has flowered, 'and the seed has been sold in the bazaar at 13 seers for the rupee, 'rice being 10 seers, the ryots having stored enough for their own 'wants in addition. Hundreds of maunds have been sold in the 'English Bazaar at Maldah; and large quantities have been sent 'to Sultangunge and other places 25 to 30 miles distant, showing 'how enormous the supply must have been. The bamboo flower- 'ing has been quite providential, as the ryots were on the point 'of starving.

'Here we have at once a key in dealing with the mitigation 'of famines in India, and bamboo reserves for famine years 'would no doubt be preferable to Mahogany and other timber 'plantations under the shade (?) of which the Bengalee ryot 'could only study the effects of hunger. Such reserves are the 'more recommendable, as there are many wastes now uncultivated 'which might be used as such, and along the Ganges endless 'savannahs expand which might profitably give way to reserves 'of bamboo. But only few bamboos would be eligible for this 'purpose, and of these Behoor bans (*Bambusa arundinacea*), Dyowa 'bans (*Bambusa Tulda*), and Basini bans (*Bambusa vulgaris*) would 'be the preferable ones, the first one being adapted also for drier 'climates, like the Upper Provinces; the two latter ones are 'preferable for damper climates, as Lower Bengal, etc. There 'are other freely flowering bamboos, especially the so-called male 'bamboo, a kind which grows, unlike the above noted, also on 'sterile rocky hills, but the seed of this kind, although larger, 'has a pretty large pericarp, and is by no means so productive as 'those kinds named above. Indeed, while here 1 to 3 seeds to 'the spikelet are found, there are as many as 4 to 8, which latter 'do not require to have the pericarp first removed, as is the case 'in the male bamboo. Unfortunately we know nothing about the 'exact quantity of seed which every stock yields, but we may 'presume that it must be enormous. We have, however, much 'to learn yet of the life-history of these bamboos before we can 'advantageously employ them for famine purposes, and first of all 'we require to know the exact age at which flowering can take

'place. Besides, yearly after sowings are necessary so as to 'ensure regularity of crop, etc. Such bamboo reserves would 'at the same time contain also other food plants, as, for example, 'Aloo, diverse kinds (*Dioscorea sp.*) say about 3–4 plants to each 'stock; *Tacca pinnatifida*; Ol (*Amorphophallus campanulatus*); 'varieties of Kuchoo (*Colocasia antiquorum and C. indica*); Tapioca 'or Cassava (*Janipha Manihot*), and such-like tuberous plants as 'do not interfere with the plantation, while their value would be 'enhanced, provided that the people could be prevented from 'using these products without a regulated control. Trees, like 'mango and jack, and in drier districts the Muhooa (*Bassia 'latifolia*) and the carob-tree (*Ceratonia siliqua*), the latter on 'calcareous sub-soils, might be added or interspersed in the bamboo 'groves. Add to the above bamboo-reserves, revised and strict 'rules regarding fisheries (for fish is an important article of food 'to a great class of natives); an attempt on the part of the 'forester to redeem the numerous courses of rivulets that are now 'dried up in the arid hills of the Peninsula, Behar, etc., by replant-'ing their sources with trees, and thus to recreate their flow, and 'have these sources combined with a judicious extension of irriga-'tion works, and I see not why famine could not be banished, or at 'least greatly diminished, so as to dwindle down to temporary 'scarcity."

There seems to be a great deal of truth in these remarks of Mr. Kurz, and they are well worthy of the attention of all officers whose lots are cast in places where action on the above lines is possible.

DEHRA DUN, N.-W. P.,
25th January, 1895. } J. NISBET.

Departmental Fellings in the C. P.

Sir,

Within the last couple of years the order has been to have departmental fellings and forest depôts at convenient distances in all Ranges. This is a simple matter where there is a fair demand for the produce cut, but where there is not—what then? Owing to the unrestricted and unregulated fellings formerly in force there is very little straight timber left in many if not most of the forests, the remark applies specially to the areas in the vicinity of large towns and markets. It is true that of late years certain species were protected from these general fellings, but the mischief had already been done, and what trees were left were mainly crooked and unsound. As a consequence, the departmental fellings (now in

'prevented a famine. Hundreds of people were on the watch day 'and night in order to collect the seeds as they fell from the 'branches. Mr. Shaw Stewart, the Collector of Canara (Western 'coast of India) states, that in 1864 a similar event took place in 'the Soopa jungles, and that a very large number of persons, 'estimated at 50,000, came from the Dharwar and Belgaum dis-'tricts to collect the seeds. Each party remained about 10 'to 14 days, taking away enough for their own consumption 'during the monsoon months as well as some for sale, and he 'adds that the flowering was a most providential benefit during 'the prevailing scarcity. Mr. Gray, writing from Maldah in 1866, 'says: 'In the south District, throughout the whole tract of 'country, the bamboo (probably *Bambusa Tulda*) has flowered, 'and the seed has been sold in the bazaar at 13 seers for the rupee, 'rice being 10 seers, the ryots having stored enough for their own 'wants in addition. Hundreds of maunds have been sold in the 'English Bazaar at Maldah; and large quantities have been sent 'to Sultangunge and other places 25 to 30 miles distant, showing 'how enormous the supply must have been. The bamboo flower-'ing has been quite providential, as the ryots were on the point 'of starving.

'Here we have at once a key in dealing with the mitigation 'of famines in India, and bamboo reserves for famine years 'would no doubt be preferable to Mahogany and other timber 'plantations under the shade (?) of which the Bengalee ryot 'could only study the effects of hunger. Such reserves are the 'more recommendable, as there are many wastes now uncultivated 'which might be used as such, and along the Ganges endless 'savannahs expand which might profitably give way to reserves 'of bamboo. But only few bamboos would be eligible for this 'purpose, and of these Behoor bans (*Bambusa arundinacea*), Dyowa 'bans (*Bambusa Tulda*), and Basini bans (*Bambusa vulgaris*) would 'be the preferable ones, the first one being adapted also for drier 'climates, like the Upper Provinces; the two latter ones are 'preferable for damper climates, as Lower Bengal, etc. There 'are other freely flowering bamboos, especially the so-called male 'bamboo, a kind which grows, unlike the above noted, also on 'sterile rocky hills, but the seed of this kind, although larger, 'has a pretty large pericarp, and is by no means so productive as 'those kinds named above. Indeed, while here 1 to 3 seeds to 'the spikelet are found, there are as many as 4 to 8, which latter 'do not require to have the pericarp first removed, as is the case 'in the male bamboo. Unfortunately we know nothing about the 'exact quantity of seed which every stock yields, but we may 'presume that it must be enormous. We have, however, much 'to learn yet of the life-history of these bamboos before we can 'advantageously employ them for famine purposes, and first of all 'we require to know the exact age at which flowering can take

progress everywhere) show that there is extremely little of building material available for sale, while the material fit for fuel is very considerable. For the former there is a ready demand and also for the latter in a few localities adjacent to large towns. But in out-of-the-way localities (and this refers to much the greater portion of the C. P.) there is little or rather no demand for the fuel material, because as regards fire wood, fencing material and grass the private and *malguzari* waste lands are practically inexhaustible. As regards timber, the *malguzari* forests are much worse than the Government Reserves, and contain very little straight wood. Therefore it is incumbent on Government to work its forests with a view to producing wood fit for building and agricultural purposes.

No good can possibly result by a relapse to the former system of commutaton and unregulated fellings to which is due the present sad condition of the Reserves. During recent years, the C. P. has been formed into two Conservators' Circles and a Forest Officer appointed to each district.

It was no doubt thought that Revenue would correspondingly increase, but this was utterly impossible while *malguzari* and others held in the aggregate such vast areas under forest, and also lands for pasture and grass. Probably, ere long, there will be a return to the old régime of one Conservator and one Divisional Officer for two or more districts, or the forest Divisions may be formed according to the lie of the ranges without regard to district limits. At present in some of the districts where there is little demand for *produce* from the Government Reserves what need can there be for a separate Divisional officer?

'COO-EE.'

1st February, 1895.

Notes on Girdling in Tharrawaddy.

(By H. Slade, Deputy Conservator of Forests.)

By "girdling" is meant the killing of teak trees for extraction. Green teak logs will not float, and it has consequently been laid down that all teak trees must be killed and left standing for three full years before being logged and put into the streams.

For the purposes of this note three sorts of girdling are distinguished, namely :—

I.—Girdling inside reserved forests.

II.—Girdling in unreserved forests not likely to be cultivated.

III.—Girdling in unreserved forests about to be cultivated.

The note will conclude with a few remarks on girdling as carried out in Upper Burma.

I.—Girdling inside reserved forests.

Locality.

The locality in which the girdling is to take place is laid down by the working plan of each working circle. As a rule in Burma the number of trees to be girdled in any particular compartment is not specified ; the working plan only lays down the compartments that are to be girdled over during the sub-period, and the maximum number of trees that may be girdled in those compartments during the *sub-period*. There are two things to be careful about :—

(1) Only to girdle within the compartments laid down.

(2) Not to exceed the maximum number of trees for the sub-period.

Season

Girdling may be carried out at any season of the year, but in the hot weather water is usually scarce and the coolies will only work during the cool hours of the morning. If an European officer is in charge of the girdling, it is almost impossible for him to work during the rains, and from December to March is undoubtedly the best season; if a Burman is in charge, it is very much better to try and get the work done during the rains, so that the revising officer has the whole of the cold weather to inspect his work.

Rules for girdling.

Within reserves gazetted Forest Officers only are allowed to girdle. Generally, the working plans lay down that in moist forest no healthy tree under 7′ girth and in dry forest no healthy tree under 6′ girth shall be girdled. Moist forest is distinguished by the presence of Tinwa, Kyathaungwa, &c., and dry forest by Myinwa. No solitary tree that will not yield a marketable log, unless, as sometimes happens, there is a hollow, worthless tree shading and over-topping healthy

trees of smaller dimensions, the killing of which would be an advantage to the forest. It is further ordered that all "*Nyaungbats*" (*i.e.*, trees attacked by *Ficus*) should be felled at once and not girdled. This will be referred to later on.

These are the principal rules for girdling in reserved forests and, if carried out to the letter, the operation cannot be said to be bad, though it may be injudicious, for, although the working plans prescribe that no tree under a certain girth shall be girdled, it is not to be inferred that every tree above the *minimum* girth (provided it is not a solitary or unmarketable tree) should be girdled. *Far from it. It is incumbent on the girdling officer to leave for* the next generation a fair proportion of the trees that he considers capable of producing good sound timber the next time the same area is girdled over. This may be considered as 30 years hence on the average. The exception to this rule occurs in places whence timber of large dimensions cannot be extracted. It is obviously useless to leave a tree of 8′ girth to attain a girth of 10′ or 12′ when no log above 8′ girth can possibly be worked out from that locality.

As an amplification of this rule it may be said that no tree of the *minimum* girth growing on the banks of a floating stream or within an easy drag of such a stream should be girdled, unless it shows signs of having reached maturity. The trees themselves will usually be the surest guide. For instance, if in a dry forest the officer notices that every tree begins to decay when it has reached a girth of 7′ it is useless for him to leave a healthy tree of 6′ 9″ in the hopes of its attaining large dimensions. The probability is that it will reach maturity within the next few years and be wholly or partly burnt before the end of 30 years.

In the same way, if in a certain forest (happily such forests are rare) he finds that but few trees reach the minimum of 6′, but begin to decay when they reach, say, 5′ 6″, he should use his discretion and girdle such marketable trees as show signs of having actually reached maturity; further, it may be laid down as a general rule that any tree, of whatever girth, showing signs of approaching decay should be girdled, provided it will yield marketable timber, and is not required for purposes of reproduction.

Unless natural reproduction is very good, a few seed-bearers should be spared along the tops of the principal ridges. Moreover, if it is a question which of two trees should be selected for girdling it is safe to say that *cæteris paribus* the one on the lower should be chosen in preference to the one on the higher ground: the area of utility of the latter as a seed-bearer is so much greater than that of the former.

Modus operandi.

We will suppose that the girdling officer has pitched his camp within a convenient distance of the place where he intends girdling. He will require two girdling hammers, one measuring tape, a good map, a

good guide, a trustworthy hammer-gaung (usually a Forest subordinate), pencils, paper, and a gang of coolies. The best number of coolies is from 10 to 15, according as the trees are scarce or plentiful. Each cooly must provide himself with a "*pauksein*" and a "*dama;*" a chisel or two are also useful for cutting through the sapwood of trees with irregular grown stems. In Upper Burma the "*kun*" (a long-headed wooden mallet armed with a broad chisel at one end) is generally used, and this excellent instrument serves the purpose of both pauksein and chisel. The guide is usually the Forester in charge, but, if he does not know the country accurately, it is better to call in local aid as nothing is more distracting than having to keep on referring to the map. The girdling officer takes one of the hammers, a tape, pencil, and paper and hands over the other hammer to his hammer-gaung. Having selected his tree, he orders one of the coolies to make a blaze on it as high up as he can reach. On this blaze he impresses his hammer-mark, writes the number of the tree in pencil on the sapwood of the blaze (it will be legible for a long time), enters this number on his list, and against it the girth of the tree measured at 6' from the ground. The whole operation takes only a few seconds and he then goes on to select his next tree. He of course numbers the tree serially.

The cooly who has made the blaze on the tree girdles it and makes another blaze as near to the ground as possible. When trees are growing on a slope, this second blaze should be made on the lower side to prevent all risk of its being destroyed when the tree is felled.

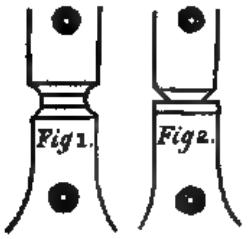
When the tree is completely girdled the hammer-gaung impresses his hammer on the lower blaze, copies the number of the tree on to his list, and against it enters the name of the girdling cooly. He then goes on to the next tree and from the numbers on his list can tell at any time whether he has missed a tree—not a rare occurrence where trees are scattered. The hammer-gaung is responsible that each tree is properly girdled, and he is forbidden to mark a tree without first going carefully round it and seeing that the work has been properly done. The coolies too should be warned against leaving the trees they have girdled until they have seen them marked and their own names entered in the register; if the hammer-gaung is delayed, they must wait by their trees and call out to him from time to time to let him know where they are.

Blazes.

Each blaze should show at least 4 inches square of heartwood and the surface should be smoothed off with a dama, or the hammer will not make a good impression. Two or three distinct hammer-marks should be put on each blaze on the heartwood; they will be visible for years.

Girdling.

The coolies should be instructed to cut a ring round the tree as low down as possible. This ring should show a width of at least 2″ of heartwood, free from sapwood, all round. If a fragment of sapwood is left, the tree will not die and the bark will gradually grow over the wound.



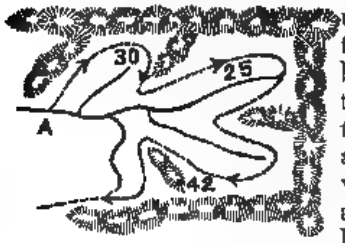
A tree properly girdled should appear as in Fig. 1, but, unless warned about it, the coolies are almost sure to girdle the trees as in Fig. 2. There is then far more chance of small connections of sapwood being left, and it is often difficult to tell if the tree has really been properly killed.

Registers.

On return to camp the registers are made up. The girdling officer from his list compiles a statement showing the number of trees of each category of girth girdled and from the hammer-gaung's list he ascertains the number of trees girdled to the credit of each cooly.

Working the forest.

It is most important that the whole of the teak-bearing area within the prescribed limits be thoroughly gone over by the girdling party. Nothing is more likely to lead to mistakes in this respect than continually crossing from ridge to ridge. Each ridge should be taken separately and thoroughly worked before another is begun. The simplest rule is to keep the hill to your right (or left) during the whole day unless you change ground altogether. Thus in girdling the head waters af a stream as here shown the arrows indicate the route that should be taken. In this case starting from A the hill is always to the left. The girdling officer should also carry a sketch map of the compartment and enter upon it the total number of trees girdled in different parts of the compartment.



From some compartments or parts of compartments it is absolutely impossible to extract timber owing to the difficult nature of the ground. A practical timber contractor is the only man who can advise the girdling officer in these cases, and it is always useful to consult a man of this class when any difficult ground is anticipated; it is obviously useless to girdle timber if it cannot be worked out.

It is also important to make the coolies themselves hunt for trees; it is heartbreaking work to have to rush up and down steep slopes looking for trees, whilst the coolies walk quietly along the main ridges. They often object at first to look for trees, but in a

few days they know exactly those that will be selected, and are as keen as terriers to find them. Those who hunt the best get the most trees and the most pay.

Rates.

In Lower Burma the ordinary rate paid to the coolies is Re. 1 for five trees; in Upper Burma it varies from two annas per tree. It is probable that the work could be done for two annas a tree in Lower Burma if additional rates were paid for particularly difficult trees. Extra rates should always be paid in fact for such trees, whatever the rate, or the coolies will shirk them, and as a rule these are the trees that require girdling. There is no difficulty in promising a cooly an extra anna or two and noting it on the list of trees.

Nyaungbats

These are doubtless a difficulty. In the older working plans it was laid down that such trees should be felled at the time of girdling instead of being merely girdled. Since then the excellent custom has been introduced of going over, before the girdling commences, the whole area to be girdled during the same year with a gang of coolies who girdle all trees that are dominating and suppressing the young teak, cut all creepers, and who lately have been also ordered to fell all Nyaungbats. The girdling officer can inspect this work whilst he is girdling, and if all the Nyaungbats have been already felled his work is considerably simplified.

The utility of felling Nyaungbats may be looked at from two points of view. First, as an attempt to exterminate the Ficus. From this point of view it is obviously useless to fell only *teak* Nyaungbats, and Nyaungbats of every species should be felled. Even then the propagation of the Ficus is so easy and its rapidity of growth is so enormous there is little doubt that in a few years it would be re-introduced from another compartment and would have completely re-established itself before the next revolution. Secondly, the killing of Nyaungbats may be considered merely as an effort to save the timber of the trees attacked. Once the Ficus has firmly established itself on a tree that tree is doomed; never can it increase in girth to any extent, and its decease is merely a matter of time. In practice the felling of Nyaungbats cannot possibly be carried out at the same time as the girdling; some of the trees would take a whole day to fell and almost as long to girdle. Knowing this the girdling officer would be forced to pass by any such trees he found, and then there is little chance of the timber finding its way to the market. The only method for that tree to be prepared for the timber contractor is for the tree to be felled, and the only way in which it can be felled is for the coolies to fell it independently of the girdling party.

With this allowed, the answer to another important question "How much Ficus on a tree makes that tree a Nyaungbat?" is obvious. Every teak tree so covered with Ficus as to render the

girdling of it a long and difficult operation is a Nyaungbat and must be felled when the works of improvement are being carried out. The girdling officer will of course select for girdling any tree in the least attacked by Ficus, provided the market value of the tree is not outweighed by its utility in the forest as a seed-bearer. Thus all the teak attacked by Ficus in any degree will be felled or girdled. With the present subordinate staff the writer cannot urge that a war of extermination be declared against the Ficus *per se*, but would confine himself to turning into cash value the teak trees attacked by Ficus.

II.—Girdling in unreserved forests not likely to be cultivated.

The main difference between this and the foregoing is that the work may be, and usually is, entrusted to a non-gazetted officer not below the rank of ranger. The old rule used to be that they girdled all teak over 6′ girth not being solitary or unmarketable trees, but there seems no reason why the limits of girth should not be the same as for reserved forests. The *modus operandi* and the rules regarding blazes, &c., are exactly the same. As a rule no works of improvement are carried out in unreserved forests previous to girdling, so the ranger has to do the best he can as regards Nyaungbats, girdling those least attacked and leaving those that cannot be girdled. If the latter are numerous, it may be as well for him to mark their position on the map and have *them felled* later. In the Toungoo division, however, creeper-cutting has been carried out by a gang of coolies distinct from the girdling coolies, and this practice most certainly recommends itself where possible.

This girdling work being entrusted to a ranger, it must be inspected by a gazetted officer called the "Revising officer." The chief points for this officer to note are :—

(1) Whether the trees are completely killed.

(2) Whether the blazes are correctly placed and cut to the heartwood.

(3) Whether the general rules concerning selection, limit of girth, &c., have been observed.

(4) Whether the trees have been properly marked.

(5) To check the number of trees.

Before starting, the ranger is provided with as good a map as possible of the area to be girdled over, and on this he carefully notes the number of trees girdled on any stream, ridge, or other natural feature. It is the duty of the revising officer to check a certain number of these areas and count the trees girdled to see if the number is correct.

To check the *manner* in which the work has been performed at least 10 per cent. of the trees should be carefully examined and the revising officer should walk round each of these trees and

examine the girdle, the blaze, the hammer-mark, the selection, and check the girth as given by the register. To check the *number* of trees girdled at least another 15 per cent. should be *counted*. As each tree bears a number the revising officer can commence from any tree and, following up the numbers in either directions, he can see whether any have been missed. The ranger will always accompany the revising officer when his work is being inspected.

III.—Girdling in unreserved forests about to be cultivated

Here the object is to girdle every tree that has a marketable value and the minimum girth will depend on the market. With this important exception the rules are exactly the same as for girdling in unreserved forests not likely to be cultivated.

Girdling in Upper Burma previous to 1890.

It must be remembered that the state of affairs in Upper Burma was perfectly different to that in Lower Burma. There were no compartments, no working plans, no reserves even; the area over which the girdling was to be carried out was limited only by the extent of the teak forest available, and this is to a certain extent still the case. The extent and very often the position of the teak forests were unknown, and had to be determined by the girdling officers. The number of trees to be girdled was also practically unlimited; a *minimum* of 30,000, 40,000 or 50,000 was fixed, but seldom, if ever, worked up to. It was obviously impossible for one or two girdling officers to personally select this huge number of trees in any one season, and this work had to be entrusted to rangers and other subordinates; but as the girdling was in reality but the first step towards the examination and subsequent reservation of the forests the work had to be closely supervised.

The following rules were laid down:—

(1) No worthless or solitary tree to be girdled.
(2) No tree under 6′ girth to be girdled.
(3) One-third only of the marketable trees over 6′ girth to be girdled.

It would have been better if the limit of girth had been 6 feet for dry and 7 feet for moist forest, and these limits have since been adopted. Rule 3 was meant as a rough and ready working plan, it being the intention to girdle over the same ground once every 10 years, so that the whole number of marketable trees should be extracted in 30 years. Each gazetted officer had under him four or five subordinates whom he had previously initiated into the mysteries of "selection;" each subordinate had under him 12 or 15 coolies, the whole working from one camp or from camps close together.

The only possible way for the revising officer to check the work was by the numbers on the trees. Lists were kept as mentioned under "Unreserved forests" and the revising officer could begin from any girdled tree, following the numbers backwards or

forwards, taking their girths and checking them on return to camp. If any particular number or series of numbers could not be found, the girdling officer had to come and point them out. The advantage, from the revising officer's point of view, of working out each ridge systematically will be apparent.

One cooly was told off each day with each party to cut creepers, for which he got eight annas. It was usual for the coolies to take turns at this work as girdling was usually much more lucrative. The lists showed the name of the cooly responsible for the creepers in each locality, and, if the work was badly done, he could always be detected and fined.

The work began during the first week in December, and was carried on uninterruptedly till the end of May. Relays of coolies used to come out (by previous arrangement) about every month.

The above remarks, as far as regards "Upper Burma," apply only to the Chindwin division, the only division of Upper Burma of which the writer has any experience.

IV.—REVIEWS

V.—SHIKAR AND TRAVEL.

"Pig Sticking Extraordinary."

The following novel method of pig-sticking may interest your readers. One evening last December I arrived late after a long march at a small Burmese village, and while at dinner was waited on by a deputation of the headmen, with a request that I would lend them some rifles for the night to shoot pigs with, as the pigs came every night to feed on the ripe paddy which was now being reaped. On my asking them why they didn't frighten them away by shouting, they informed me that that was no use, as the pigs were so bold that one could ride up to them on buffaloes and stick them with a spear. Anxious to try this, I went off to the paddy fields, and there, sure enough, in the bright moonlight were to be seen the ghostly looking forms of several buffaloes being slowly ridden about by spear-armed Burmans. Already one rider had speared a pig, but the spear not having been driven home the pig escaped. I tried to mount several of the "steeds," but not one of them would allow me anywhere near, much less on its back; the village elder politely explaining that "the buffaloes could not stand the stink of my Lord." I thereupon watched in the field, hoping to see a spear, but about one o'clock the mist came down and covered everything, making the cold too deadly, so I returned to camp, leaving a rifle with the headman who shot a large boar, not more than half an hour after I had left, having ridden up to within a yard of the animal. The spear used is about 10 feet long of native manufacture, with a heavy blade barbed on one side. The villagers informed me that they sometimes speared a Sambhur, in the same way, *in the fields at night.*

The extraordinary thing to me is that the pig or Sambhur does not wind the man riding, as I guarantee most Europeans could at more than one spear's length; as of course "the animals being so bold" is all humbug, or else one could walk up to them, which one cannot do.

TAWKWE.

Elephant Catching Operations.

SIR,

I have read with much interest Mr. Bryant's account of elephant capturing operations in the Anamalai Hills, in the January Number. I notice, however, certain changes have

apparently been introduced in the rules which were published by the Board of Revenue in September 1892, and I question whether any advantage has been gained by the changes.

The rules prescribed for pits 12 ft. by 12 ft. at top and 9 ft. by 9 ft. at bottom. The sloping sides are, as mentioned in the rules, intended to break the fall. Mr. Bryant ignores this precaution, and substitutes for it the filling up of the pit with brushwood. Now I really question whether brushwood is really efficacious, and there is one great objection to urge against its use. To be of any effect *at all the brushwood* must constantly be removed, with a result that the cover of the pit has to be removed from time to time, causing disarrangement of the soil, which is likely to attract the notice of the wild elephants and render the whereabouts of the pits known,

Mr. Bryant has produced no reasons for preferring pits with vertical sides, except the success which has attended his operations in recent years. He has, however, noticed the injury to the face, so often noticeable in captures, and states that he has had no accidents of this kind of late years. It is, I consider, more a question of good luck than good guidance, as this injury is not caused, as he supposes, by the fall, but by the subsequent attempts on the part of the captive animal to escape from the pit. It is on this account that cows more often suffer from this injury than tuskers, as the former in lifting their heads break their chisels short against the sides of the pit, and afterwards the broken chisel adds to the injury when the animal rubs against the side of the pit. This injury is, I maintain, more likely to happen when the sides are vertical than when they are sloping.

Again, Mr. Bryant calls attention to his recent successes, and shows that none of his late captures have died. Is it not a little early to judge? (I notice in passing that he has accidentally omitted from his tabulated list one of his 1891 *captures which died*). *Of the 18* captures, 6 have died. Of these the date of capture and death of two is not known; of the others one died from an injury in the face. The other three all lived for more than six months, and two for nine months after capture. Admitting that his 1893 captures have passed the dangerous periods, is it not possible that there may be casualties amongst the four captures in 1894, which form a considerable percentage of those still left alive? I do not wish to be a bird of ill omen, but the height of no less than three out of the four exceeds the height prescribed in Rule 4; and judging from their height alone it is not unlikely that they will die, not from injuries but through pining, as they are probably advanced in age.

Mr. Bryant asks us to judge by results; but after all, are these results so successful as to induce us to alter our mode of operations? Out of 18 elephants captured in the Anamalais, six deaths have occurred. In this district 24 have been caught, out of which four old cows have been released from the pit. Of the remaining 20, two have been sold, one young tusker realising the fancy

price of Rs. 4,800, and three have died. Fifteen are still living, of which one was caught in 1893 and two in 1894. Of the three that died, one was the second capture made, which died from pining, and should have been released from the pit instead of being taken to the kraal, and one was a very small baby, only a few months old, which died of diarrhœa brought on by incautious feeding. Result—seventeen living out of twenty.

Two other points of comparison may be of interest to your readers :—

(1). In Malabar the mode of bringing to the kraal slightly differs from that employed in Coimbatore. It is found very necessary to have two tame elephants, one on either side, as well as those mentioned by Mr. Bryant, before and behind. Otherwise some of the larger elephants break away whilst being led to the kraal. But the circumstances differ, for the lead here is from 12 to 15 miles, and not two miles as in Coimbatore.

(2). Mr. Bryant gives three months as the time for being kept in the kraal. This is sufficient to tame, but here the elephant is not only tamed, but also schooled in the kraal, and is therefore confined for six months. The two elephants transferred from Coimbatore were *tamed, but not schooled ; and had to be put in the* kraal for two months subsequent to their arrival.

One word more, although I fear that I have already trespassed on your space. Mr. Bryant says that the size of the captured elephant's neck is estimated, but has omitted to say how the estimate is made. Whilst in the pit the height of the elephant is measured as follows :—One man puts a stick alongside the animal, holding it upright ; another man from the side with a stick covered with mud cuts the upright stick just above the withers of the animal. This gives the height of the elephant. The measurement of the neck is found by deducting one-eighth from the height measurement. This hint may be useful to officers engaged in elephant catching operations if they are not already aware of it.

NILAMBUR :
1st Feby. 1895. } G. HADFIELD.

VI—EXTRACTS, NOTES, AND QUERIES.

The Forests of the National Domain in America.

The small company of forward-looking people who, in the face of almost universal apathy, had been for years urging the necessity of some rational system of management for the forests on our national domain, felt greatly encouraged ten years ago when President Arthur was moved to mention the subject in one of his annual messages. We have no systematic forest policy yet, nor even the beginning of such a policy, but we are no longer surprised or unduly elated over the fact that men in places of high authority consider the matter worth talking about, at least. President Cleveland, like his immediate predecessors, in his message to Congress, which assembled last month, strongly advised that some adequate protection should be provided for the areas of forests which had been reserved by proclamation; and he also recommended the adoption of some comprehensive scheme of forest management. He condemned the present policy of the Government of surrendering for small considerations immense tracts of timber-land which ought to be reserved as permanent sources of timber-supply, and urged the prompt abandonment of this wasteful policy for a conservative one, which should recognize in a practical the way importance of our forest inheritance as a vital element of the national prosperity.—(*Garden and Forest.*)

Timber of the Sandwich Islands.

Those familiar with lumber matters know that an important consuming section to the manufacturers of lumber on the Pacific coast of the United States is made up of the Sandwich Islands. It is somewhat surprising to learn, therefore, that these islands

other articles of barter. They set the common people of the natives to dragging the sandalwood down from the mountains, which labour had to be performed at the order of the chiefs without compensation. Therefore, to avoid this unremunerative labour—and labour of any sort is not congenial to the Sandwich Islander—the natives burned the forests. Recently, however, surveyors who have been on the mountains say that sandalwood is again springing up from the old roots, promising to re-forest the districts which it formerly occupied.

Another remarkable wood of the island is the kawilla. It was used for spears and such purposes, and for this was seasoned in the sea for ten years, during which time it became heavier than iron. Many specimens are still found thus seasoned, and something of the sort is still done.—(*Timber Trades Journal.*)

Red Cedar Doors.

The *Puget Sound Lumberman* refers to a shipment of 500 red cedar* doors and a quantity of window frames, by a Tacoma concern, to Johannesburg South Africa. That journal regards this shipment as marking another step in the door trade of the Pacific north-west. It goes on to state that only three years ago the coast cedar door trade was unknown east of the Cascade mountains, which divide eastern and western Washington. The bulk of the doors used at Spokane, Walla Walla, and in other eastern Washington towns, came from Minneapolis. Montana's doors came from Anoka, Minneapolis, and St. Paul, while Utah and Colorado obtained their doors largely from Muscatine, Ia., and Kansas City. Now things have changed. White pine doors have been driven out of eastern Washington, and Montana, Utah, and Colorado are beginning to find that cedar makes excellent doors, and the result is that shipments are being made from coast ports every month. Not only so, but the States further east are being invaded by doors from the Pacific north-west. During the past year, Iowa, Minnesota, Nebraska, and Missouri dealers have bought coast cedar doors, and the Tacoma paper predicts that within two years they will be as rife in the States east of the mountains as red cedar shingles have become.

A year ago a Tacoma firm began work on the Atlantic coast. The first shipment of doors went to Bangor, Me. Since then shipments have been made to New Jersey, New York, and Pennsylvania. A recent shipment went to Philadelphia. It is said that at Oshkosh, Wis., a sash and door concern, seeing possibilities in red cedar doors, is making an article veneered with cedar, and an Iowa concern is experimenting with a solid cedar door. Within the past year red cedar doors have been introduced into Japan, China, and Hawaii, and a British Columbia firm will send a few to England and France as an experiment.—(*Timber Trades Journal.*)

* NOTE :—*Juniperus virginiana*, we believe.—HON. ED.

Buried Wood

The French Consul at Montgze, in Upper Tonquin, tells of a very curious mining industry which is carried on there, which represents a source of great wealth. This is comprised in certain mines, where are found buried the trunks of enormous pine-trees which have been swallowed up in some long-forgotten convulsion of nature. Many of these trunks are a yard in diameter, and the wood they furnish is of an imperishable nature. For this reason, the Chinese value it for making coffins, the sanitary advantages of earth-to-earth burial not yet having reached that part of the world. (*Chambers Journal.*)

Planting Shifting Sands

Tree-planting by the sea-coast, even under the most favourable conditions, is always attended with considerable difficulties, but when shifting sands, such as those of the Norfolk coast, have to be dealt with, the crosses to be encountered in so doing are usually considerable. One of the most successful experiments of late years in reclaiming waste sandy lands on the sea-coast is that which has steadily been prosecuted since 1850 on the Holkham sandhills, the property of the Earl of Leicester. Formerly these sandhills were rabbit warrens, but by a carefully arranged and judicious system of planting, the formerly shifting and blowing sands have gradually been converted into a thriving plantation, thus forming a shelter to the adjoining pasture land and a distinct and ornamental feature of the landscape as well.

The sea lime grass (*Elymus arenarius*) and the still more valuable marrum or sea matweed (*Psamma arenaria*) have been largely used in the binding of these shifting sands, the running root and spreading growths, and still more the particular nature of the plants in being able to succeed, nay, even luxuriate in such meagre surroundings, soon binding together the dry and loose sand, and thus acting as pioneers to other more valuable forms of growth.

The trees employed in conjunction with the above grasses are the Cluster, Corsican, Austrian, and Scotch pines (*Pinus Pinaster, P. laricio, P. austriaca, and P. sylvestris*, and to show that they have succeeded well we need only add that many of the trees are now 40 feet high, and well clothed with the thickest and freshest of foliage. The Corsican pine has succeeded probably best of any. (*Timber Trades Journal.*)

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The Diseases of Trees.

Apart from the natural processes of death and decomposition, to which all organisms are liable, the vast majority of the individual species of animals and plants seem to be subject to diseases of one sort or another at different stages of their development. Naturally, those which affect man have from time immemorial received the first and closest attention ; next come those interfering with the usefulness of the animals, which man has made subservient to his purposes for agriculture, trade, and locomotion. But it is only within comparatively recent years that any great amount of attention has been bestowed upon the diseases of plants.

As might be expected, the analogy between animal pathology and vegetable pathology is usually close, except as-regards the heredity of certain classes of diseases, which is confined entirely to animals. Abnormal and diseased conditions are produced in both by unfavourable external circumstances; death and inability to regenerate themselves are with many different species of plants and animals the results either of exposure to excessive heat or cold, or of prolonged existence in solar and atmospheric conditions dissimilar to those obtaining in the localities to which they are indigenous ; organic disturbances are known to affect and heighten the normal temperatures of the blood of animals, whilst certain physiological disturbances have been proved to heighten the normal temperature of the sap of plants; and both are subject to infectious diseases occasioned by lowly organisms, whose biological position is in the almost undefinable borderland forming a sort of neutral zone between the Animal and the Vegetable Kingdoms. This latter class of pathological causes is by far the most important to the human race, both as regards the diseases of animals and those affecting plants ; for the *parasitic diseases*, in addition to creating physiological disturbances in the individual, often resulting speedily in death, have the unfortunate power of being communicable to other individuals by infection or contagion. Such are

the zymotic or inflammatory diseases which often become epidemic and extremely fatal to man and the lower animals, and the fungoid diseases, many of which also exhibit epidemic tendencies, among plants.

Since the foundation of the new science of Mycology by Berkeley, de Bary, and Tulasne, much has been done towards building up a knowledge of the biology of fungi, both in Europe and in America; whilst the laboratories of Hartig, von Tubeuf, Frank, and Sorauer in Germany, of the Government Mycologist in the United States, and of Marshall Ward in England are constantly busy with the elaboration of contributions towards a more complete knowledge of the parasitic fungi occasioning diseased conditions in plants of agricultural or sylvicultural value. There can be no doubt that if the work of the mycologists were more closely studied by doctors of medicine than it is, many useful hints would be obtainable, which might lead to important discoveries regarding the cause of disease in man. The following example will indicate what I mean. The shoots of the Scots pine are liable to be attacked by a fungus *Cæoma pinitorquum*, whilst the foliage of larch suffers from the attacks of a very closely allied species, *C. laricis*. Each of these fungi is unable to reproduce itself by direct generation; it must first of all pass through an æcidial form, or indirect stage of generation, as a *Melampsora*, before it can become regenerated in the original forms of *C. pinitorquum* or *C. laricis*. Now comes the striking part of the matter, for there is very good reason to believe that *C. laricis* and *C. pinitorquum* can both of them pass through their æcidial stage either as *Melampsora tremulæ* on the aspen, or as *M. betulina* on the birch; and in the same way each of these two forms of *Melampsora* may develop either into *C. laricis* or *C. pinitorquum*, according as the spores chance to settle upon and manage to infect the young shoots and foliage of the larch or the pine. This is something quite different from the 'parthenogenesis' and the change of generation often seen in the animal kingdom, as, for instance, among the *Cynipidæ*. Thus, the pine-shoot fungus may become a rust on aspen foliage, or a different rust on birch foliage; and in the succeeding form it may become either the pine-shoot fungus again, or the rust to be found on the foliage of the larch. And in the same way the larch rust may affect either the aspen or the birch in its æcidial stage, and may then revert to the original form, or else become transformed into the pine-shoot fungus. The possibilities that are thus opened out to medical science are immense. Take, for example, the recent epidemics of influenza. There is no reason why the bacterium, which most probably causes this wide-spread and now oft-recurring epidemic disease, may not have a change of generation with some other disease, perhaps even a very minor disorder, affecting either human beings, or cattle, or domestic animals. And, arguing from analogy, as one seems perfectly

justified in doing, there is no reason why the germ causing the disease influenza may not have a change of generation with a bacterium causing what appears to be quite a different species of disease. Hence, careful study of, and investigation into, all the diseases that are or have been either precedent to or concurrent with any recent outbreak of influenza, might ultimately lead to a true knowledge of the cause of the disease, which must ever be the first step towards combating it most successfully.

Whilst Pasteur has been the leader and the most eminent of the workers in this new domain of knowledge as affecting the medical profession, Professor Robert Hartig, of Munich University, has been the Pasteur of the diseases of forest trees; although the credit of having been the first to stimulate interest in this direction undoubtedly belongs to Moritz Willkomm, who published *Die Mikroscopischen Feinde des Waldes* in 1866-68. More than twenty years ago, while Hartig was Professor of Botany at the Imperial Forest Academy, Neustadt-Eberswalde in Prussia, he published (1874) his celebrated work, *Wichtige Krankheiten der Waldbäume*, or "Important Diseases of Forest Trees." The value of this contribution to forest literature was not adequately or speedily recognised by the teachers of forestry of that day; and a good deal of ridicule was cast on a study which is now, by every scientific forester on the Continent of Europe, admitted to have a very distinct and direct practical value. The scoffers maintained that the fungi found on trees were *secondary*, or results, and not *primary*, or causes; but Hartig was able to prove his case by experiments in which healthy woody-plants were brought into a diseased condition through artificial infection. Various works, papers, and brochures were published by Hartig before the issue of his *Lehrbuch der Baumkrankheiten* in 1882. A second edition of this work appeared in 1889, embodying the results of the active advance of mycological science; and now what is practically a third edition has just appeared in an English form as a *Text Book of the Diseases of Trees*, by Professor R. Hartig, translated by W. Somerville D. Oec, of the Durham College of Science, and edited by Professor H. Marshall Ward, of Coopers Hill College, (Macmillan and Co., 1894).

During the generation that has just passed since the formation of the Forest Department under the Government of India, and the introduction of Forest Administration into the various provinces under its rule, the officers of the Forest Department have had too much to do—in the way of organizing work, selecting and demarcating reserves, improving the methods of extraction, trying to form a market for fine woods which have as yet little or no market value beyond what is merely local and comparatively insignificant, improving communications, protecting the better and more valuable tracts from the destructive effects of jungle fires, overgrazing, &c.,—to admit of their devoting any attention to such apparently trivial

matters as the diseases of trees. But it is only reasonable to suppose that as time goes on, and forest work in India becomes more intensive, this new branch of scientific forestry will gradually receive more or less of attention. And for those who wish to devote a portion of their leisure time to the interesting study of the pathology of Indian forest trees, there can be no better guide than Hartig's text-book in its English form.

We know, for example, that many of the oldest teak plantations throughout India were formed on rich alluvial soils which, owing to their comparative fertility and to their richness in the soluble salts forming the food of plants, are never likely to yield such hard, heavy, close-grained wood as that produced on the drier hillsides, from which timber of the finest quality is obtained. Though producing a very much quicker growth of teak, these alluvial plantations can never be expected to furnish supplies of the finest quality of timber; and if the degree of fertility exceeds a certain (indefinite) limit for the given circumstances of soil and situation, then it seems almost certain that there will be at least a *predisposition towards disease* either in individual stems or as a general characteristic of the whole crop.

This being the theoretical statement of a case which is of vast practical value with reference to plantation work, the question immediately suggests itself, —*Can any such results be proved as having actually occurred?* My answer is '*yes*'; for I find the following extract in my diary of 29th January 1881, during my inspection of the Hill tracts of Norther Arakan:

"*Teak.*—Up to 1879 a police guard was stationed at Sawa, and, as 'was done at every other guard seven or eight years ago, an experiment-'al teak plantation was likewise formed here. It is now a clump of about '200 poles, growing over level, rich, very deep, alluvial deposit in prox-'imity to the river's bank. As in the case of all the similar plantations 'I have reported on, this clump is badly in want of being thinned out to 'the extent of about 50 per cent. Its crowded condition may be judged 'of when it is said that in girth the poles vary from the circle formed by 'thumb and forefinger up to three full spans. The average height of the 'dominating poles is about 35ft. to 40ft., and the mean girth 14in. to 15in. 'The maximum girth of three spans is attained by six individual poles. 'The distances at which the plants were planted out seem to be very 'irregular, but the whole covers about one-fourth of an acre.

'With reference to what I have remarked about the Myauktaung teak 'plantation, *viz.*, that the excessive richness of the soil (combined with the 'questionable drainage of the area during the rainy season), it being so 'much in excess of the fertility of the soils on which teak is indigenous, 'and over which it attains its greatest perfection, *would probably induce 'a spongy growth or fungus development before the trees arrived at the 'age of maturity*,—an example from the Sawa plantation may be quoted. 'One of the largest of the poles that had been growing at the north edge 'of the plantation (*i.e.*, in the position most sheltered from the winds),

'with a fine, normal development of branches, and hence of the root-sys-
'tem (that developing *pari passu* with the branch system), had, without
'any good and sufficient reason, simply fallen down, broken off just about
'three-inches above the ground. It was no rugged tear as if the pole
'had been thrown by the force of the wind. On examining it, no trace of
'insect-boring, or other visible cause, was assignable. On chewing a bit of
'the wood, however, the taste felt was decidedly that of vinegar, showing
'that from the combined effects of excessive fertility and imperfect drainage
'of the soil, the sap had been interfered with, had become decomposed, and
'undergone fermentation resulting in the death of the tree.....Although
'the woody, fibrous parts thus exposed were in an unhealthy condition,
'yet the bark, and stem, and branches had outwardly quite a healthy and
'vigorous appearance."

So much for too great fertility in the soil. But the opposite extreme may be productive of very similar results—a predisposition to fungous diseases. Insufficient supplies of food in the shape of soluble mineral salts, and more particularly want of a sufficiency of soil-moisture for the supply of the physiological requirements with regard to water of transpiration, produce very much the same practical results as when the root-hairs of the plants tend to gorge themselves with rich food beyond the actual physiological requirements of the individual plants. As this, however, is again a purely theoretical statement of the case, it must also be met with the question as to whether or not practical examples can be pointed to; and here, too, practical experience and theory harmonise, as may be abundantly proved on the limestone hills of Bodyar in the Jaunsar Division of the School Circle, N-W. P.

The re-wooding of these bare hillsides, with their shallow soil and their hot southern exposure, forms a difficult sylvicultural problem. Whilst the ultimate object to be aimed at is to clothe them with forest in which the ruling species shall be the valuable Deodar, this object will practically only be attainable by indirect means, and after a considerable lapse of time. As the elevation is above that at which the Chir pine (*P. longifolia*. occurs frequently in this part of Jaunsar, the principal tree to be made use of as a nurse, under whose shelter the Deodar can be raised, should be the Kail (*P. excelsa*), which is not infrequently found seeding itself naturally here and there, and forming a lightly foliaged patch of young trees, beneath whose grateful shade Deodar seedlings find the conditions apparently most suitable to their initial growth and development, namely, sufficient overshadowing of the ground to help to retain the soil-moisture, and to prevent the seedling suffering from the effects of the excessive transpiration that would be induced by complete insolation. Various methods of sowing and planting appear to have been tried in the past, mostly with but poor success; and the present method is the somewhat expensive one known as '*basket-planting*.' But even with the minimum of disturbance thus secured to the young nursery-bred Deodar,

the effects of exposure to the full blaze of the scorching sun on these hot, dry, southern exposures has in very many instances led to the foliage becoming infected with a minor parasitic disease, which exhibits itself in the form of small yellow pustules (*sporophores*), that ultimately turn black as they mature and dry.

Fungous diseases of various kinds are exceedingly common on the conifers throughout Jaunsar-Bawar, and, of course, more especially on the southern exposures where the conditions as to insolation, food-supplies, and water of transpiration are very much more unfavourable than on the cooler and moister northern aspects.

On the vast majority of the Himalayan spruce (*Picea Smithiana*), which occurs so abundantly throughout the whole of the Jaunsar Division, in association chiefly with the Himalayan silver fir (*Abies Webbiana*), a fungous disease attacks the terminal shoots of the lower branches, transforming those into bright orange tassels (Plate *a*) which, after bursting and scattering their spores, become blackened and shrivelled up as if they had been scorched and withered by fire (Plate *b*). This fungus, identified some years ago by Dr Cooke as *Æcidium Thompsoni*, seems to bear a very close relationship to the *Æcidium coruscans*, or rust-fungus common on the spruce of Sweden and Finland, which also attacks the young shoot and affects the whole of the leaves. These become occupied by a peridium, which ruptures either partially or along the whole length of the needle and shows the golden yellow æcidia beneath. The fleshy cone-like transformations of the shoot are eaten in Sweden; but the attention of the Himalayan peasants does not yet appear to have been drawn to the large possibilities before them in this respect every April and May. Sometimes the spruce are almost completely covered with these bright orange tassels, excepting the leading-shoot, which happily appears exempt from infection; and there cannot be the slightest doubt that if spruce were now a marketable tree, the great prevalence of the disease would be sufficient to draw practical attention to the advisability of trying to prevent the spread of the disease by lopping and burning all shoots within convenient reach. The teleutospore-form in which this *Æcidium* has its change of generation is not yet known. Leaf rusts are not confined to, or by any means so frequent on, Deodar foliage as on the needles of spruce and pines throughout Jaunsar. That on the Himalayan spruce (Plate *c*) was identified by Cooke as *Peridermium acicolum* (now better known as *Peridermium pini acicola* or *P. oblongisporium*), which is the æcidial form of the *Coleosporium*, that attacks the foliage of herbaceous plants like *Senecio*, *Euphrasia* and *Tussilago*. But the most striking and the most abundant leaf-rust is that on the foliage of the Kail pine (*P. excelsa*), designated *Peridermium orientale* by Cooke, which has been described in the *Indian Forester* (Vol III, page 88), and is now shown in the plate. During the months of April and May the *æcidia* are noticeable on the one-

year-old foliage of seedlings and saplings chiefly, though occasionally of older poles. The spermogonia are found among the yellow, pale orange or salmon coloured pustules which break through the cuticle of the leaf; and when those become dry and brown with age, they look like small black blotches. The mycelium develops inside the leaf, where it hibernates; and in the following spring it may again produce *æcidia* without killing the leaf. As the foliage does not die at once, or at least to any great extent, this fungoid disease is not of any very important character.

A more destructive disease is that occasioned by *Hysterium pinastri*, which was first noticed by Professor Heinrich Mayr (then Assistant to Hartig, but deputed by the Bavarian Government to visit the forests of North America, Japan, and the Himalayas) in 1885, when he found it on the Chir pine (*P. longifolia*) of the Lurli plantation. This disease, which has become the scourge of nurseries and young plantations throughout Germany in the last thirty years, appears first as yellow spots that spread out and turn the whole needle red, and often kills off the young plants when about one year old. This parasite is all the more dangerous, as it is saprophytic as well as parasitic, and can therefore reproduce itself upon the dead foliage lying on the ground.

Another form of fungoid disease occurring in Jaunsar is the *Peridermium pini corticola*, occasionally to be found on the stems of young pines, both Chir and Kail. Infection probably takes place at some point where an injury has been sustained (from an insect, hail, &c.,) and the mycelium spreads first of all within the cortex and then attacks the adjoining tissues, the rate of progress being usually somewhat more rapid longitudinally than horizontally. For the most part the *æcidia* are formed only where the cortex has become diseased during the preceding year; and there they protrude as large, bright, yellow or orange pustules of various shapes in May and June, which soon burst and scatter abroad their countless reddish-yellow spores. Like the majority of the other conifers of Jaunsar, the Leori (*Cupressus torulosa*) does not entirely escape fungoid disease, but is often largely attacked—more especially on hot southern slopes, of course—by a *Nostoc* (see Plate) or mucilaginous mass of brown teleutospore-layers which appear spirally round the stem. When this mucilage-like mass drops off, or becomes washed away by rain, small scars remain either exposing the woody tissue of the twig, or else forming excrescences on the bark. This *Nostoc* or cypress fungus is due to *Gymnosporangium Cunninghamianum*, whose teleutospores are each autumn developed under the outer cortical layers, and in spring they break through the cortex, appearing, often very profusely, in their mucilaginous masses. These fructifications consist of long filamentous basidia whose outer wall has become transformed into this gelatinous-like mass, and of the two-celled resting-spores borne at their apex. Within this mucilaginous mass, which

is soluble in rain water, the formation of the promycelium and sporidia takes place. On being liberated, the sporidia are conveyed by the wind to the foliage of various pomaceous trees, most probably to *Sorbus* in the case of the Cypress *Nostoc*, where they produce the *Æcidium Cunninghamianum*.

The common rust which attacks wheat and other grasses is frequently to be met with in Jaunsar as the Barberry fungus (*Æcidium Berberidis*) on the leaves of the Himalayan Barberry (*Berberis aristata*—see Plate). When infected, the leaves become thick, fleshy, and yellow, whilst the sporophores occur as bright orange-yellow pustules thickly scattered over the lower surface of the foliage, although a few also break through the cuticle of the upper surface. Infection probably takes place at the time of the opening of the buds, so that the development of the leaves speedily becomes arrested. The leaves infected—which not infrequently includes all the leaves of the short shoot in question -consequently become thickened, and remain more or less abortive. The sporophores ripen quickly, and shed the spores towards the end of April when they are scattered far and wide by the wind to produce the rust on wheat (*Uredo linearis*) and mildew on various kinds of grasses (*Puccinia graminis*).

But one of the most beautiful of all the diseases of the Himalayan trees is that caused by a species of *Exoascus* on the cinnamon tree (*Cinnamomum Tamala*). This disease, ultimately causing a cluster-like deformity of twigs and foliage similar to the so-called 'witches-broom' of the birch in Europe (also caused by an *Exoascus*), takes the form of a dense mass of bell shaped or crinkled excrescences of a beautiful pearly grey colour, which in form much resemble the malformations produced on a less luxuriant scale by *Exoascus alnitorquus* and *E. epiphyllus* in the fruits and the foliage of the common alder.

This branch of vegetable pathology has previously been introduced to the notice of the readers of the *Indian Forester* on more than one occasion, as may be seen on reference to Vol. II page 380, Vol. III pages 24 and 89, and Vol. XVIII page 21; and it has also been referred to on page 38 of Mr. Hearle's *Working Plan of the Deodar Range*, Jaunsar Forest Division, N-W.P., 1889. But to those who may wish to cultivate a closer acquaintance with the Diseases of Trees, Hartig's text-book can be warmly recommended. His companion work, *Anatomy and Physiology of Plants, with special reference to those of Sylvicultural Importance*, will also be issued in an English form during the autumn by Mr. David Douglas, the well-known Edinburgh publisher.

DEHRA DUN, N-W. P.
24th February 1895.

J. NISBET.

System of Tapping the Caryota Urens for Toddy in Travancore.

Although the *Caryota urens*, under the local names of Olathi, Choonda and Kali-pana, is met with in most of the cool shaded valleys and lower hill-slopes of the cultivated parts of Travancore, it is, as a rule, tapped in only a few of the districts in the inner North-Western part of the country. Its great ashy-green fronds of leaves which often serve to decorate some gay pandál; the stiff, dark fibres of its leaf-stalks locally used as fishing-tackle; its huge trunk which, when dead and hollowed out, is made into gutters and troughs; its soft, inner pith that sometimes takes the place of Sago,—are, in their way, useful, and among the many products it is capable of yielding: but, from its almost general utility in the localities in which the Caryota is tapped, its toddy is by far the most important product. Toddy is not, as some understand it to mean, the harsh alcoholic liquor obtained by distillation from the fermented sap of the palm; but it is the delicious, milk-and-water like, sugary sap itself as, cool and refreshing, it flows out at the cut-end of the flowering-spathe. The cocoanut, the palmyra and the Caryota has each its own distinctive method of tapping, but, perhaps, the most laborious, yet interesting, system, is that followed in the extraction of the toddy from the gigantic flower-branches of the last.

In North Travancore, where, more than in most other parts of the country, a perennial humidity pervades the air, the cocoanut, the Areca, the Talipat, the palmyra and the Caryota, glorying in the gay sun-shine of their tropical day, bathed in the copious showers of the monsoon rains, bedewed by the translucent condensations of the night-air and fanned by the perpetual breezes from the sea, bear up their imposing tufts of foliage high into the sky. Of this remarkable brotherhood, the Caryota, though one of the biggest, is yet the shortest lived; for, attaining its greatest dimensions in about twelve or fifteen years after sowing, the tree gives out its huge clusters of flowers for another two or three years at most, and then declines and dies long before its more fortunate associates will have arrived at even middle-age. Within the short period of its existence, however, it proves, in its own way, a useful and valuable tree; for, from the time it attains its greatest height down to a late day in its life, *its grateful, nourishing sap administers to the sustenance and comfort* of many hundreds of the lowest agricultural classes of the country. The noon-day meal of the Poolaya generally consists of nothing more than a long-drawn draught of sour toddy which, in his short hour of respite, he cheerfully drinks to the accompaniment of much rural gossip and prattle, with the companions of his toil sipping with him.

"Tapping," as applied to the several species of palm from which toddy is extracted in Travancore, consists of two distinct operations—"training the spathe" and "tapping-proper." In the case of the cocoanut and the palmyra, the training or preliminary, stimulative manipulation of the unexpanded flowering-spathe as an incentive to the flow of sap is always antecedent to the tapping proper, which consists in the methodical paring and slicing of the lower, free end of the spathe, at certain fixed hours of the day, to let out and, so gather, the pent-up toddy that collects in its spikes through their training. In the case of the Caryota, however, its giant clusters of flower-buds are too stiff and stubborn to yield their juice by a single process of training, and that operation is therefore made to alternate with the tapping-proper in a regular series or succession in which they are each repeated several times.

On the Caryota attaining its fullest dimensions—usually, a height of from 40 to 60 feet and a basal girth of about 3 or 4 feet—it gives out its first flowering-spathe which, appearing at the summit, stays the tree's further growth in height. A healthy, vigorous tree generally has from fifteen to twenty fronds of leaves, and once flowering begins, a spathe is let out at the axil of each frond. As they travel downward, the spathes increase in size until the middle of the crown, where the largest is given off, is come to: thereafter, they not only grow smaller but emerge at longer intervals, and, in a year or two after the last and smallest cluster matures, the tree itself speedily declines and dies. Wherever it is untapped, the Caryota, stamping a peculiar melancholy feature on the physiognomy of the vegetation around it, lives on for several years; but in localities where tapped, its vital energies come to be so incessantly and powerfully taxed, that, in the re-action which sets in, the tree dies at a comparatively early age. The first spathe let out is generally small and ill-formed and, as it would not pay being tapped, it is let alone. But when, a month or two later, the second spathe appears, the tapping of the tree is taken in hand. A couple or more stout bamboos with portions of the arms retained on each side to serve for steps, are tied on to the stem of the tree, one above the other, until they form a ladder long enough to reach the spathe; and at the top, directly below the spathe, a rude platform of little sticks is constructed for the tapper's use. This individual, usually a man of the Chöga, or "Tapper caste," now ascends the tree and, perched on his platform, proceeds to cut away that portion of the tough sheath which encloses the long, tender, flower-spikes of the spathe: the remaining part of it protecting the peduncle of the spathe itself is, however, allowed to remain to shield the latter from the direct heat of the sun or any other external influence likely to injuriously affect it. The spathe, at the time the sheath is thus removed, will have just completed its elongation, but will not yet have burst open. On removing the sheath, the delicate spikes of unex-

panded flowers are all unravelled and stretched ; but they are, soon after, wrapped up in a few strips of Talipat leaf and tied round with a little coir rope. Early the next morning the spathe is untied and the spikes of embryonic flowers are taken, one at a time, between the fore-finger and thumb of each hand in succession and gently, yet firmly, pressed. This operation, the first step in the training of the spathe, begins at the attachment of the spikes with the peduncle and, proceeding with an even, rythmical regularity along their entire lengths, is continued down to their free ends. It is repeated several times over each and every one of the three or four hundred spikes in the spathe—an extremely tedious operation, but conducted most patiently and carefully. Every morning, six days following the unravelling of the spikes, this monotonous pressing goes on, the spathe being, during the intervals, carefully wrapped up in its shroud of Talipat leaf. On the sixth day, after the training for the day gives over, about six or eight inches of the sheath left covering the arched end of the peduncle is carefully cut and removed ; the dense, rusty tomentum on it is scraped together and ground, with a little sour toddy, into a stiff paste ; the exposed part of the peduncle is gently bruised with a smooth stone and the paste applied over the bruise. This bruising of the peduncle is said to arrest the further development of the fibrous tissue in the spikes ; it, at any rate, makes them limp and pliant : the paste is applied to exclude the air from the injured part and, so, to prevent decay. The spikes are usually from five to seven feet long, and the next step consists in the cutting away of their lower, free ends for about six or eight inches of their length, care being taken that every spike is clean-cut *and to the same* length. To ensure this, the spikes are, before being cut, bound together into a compact bundle. For the next ten days the spikes are taken, one by one, between the fore-finger and thumb of each hand, as before, and twisted by a dexterous, tilting action, proceeding at first from left to right and then reverse ways, and continued like the pressings from the insertion to the free end of each spike. For the next two or three days the spikes, placed between the palms of both hands, are gently rolled about backwards and forwards *for several minutes each. By the time this operation* ceases, the young toddy begins to flow. No attempt is, however, made to collect this astringent, sub-acid juice, but, under the name of "Kaippan mara-vellam" (bitter tree-water), it is allowed to drip to the ground for a couple of days. On the third day, the pot, usually an earthen vessel, is tied on to the cut end of the spathe and a piece of the lower petioloid expansion of the leaf-stalk of the areca palm is tied all round the rim to prevent the rats, squirrels, bats, pole-cats and flying-foxes from prying into its contents. The monkey is, however, *the only animal that cannot be kept away* when he decides upon taking "a drink" ; but the penalty of his indulgence too often overtakes him in the midst of his Bac-

chanalian enjoyment, and he is found most disgracefully "tight," either tottering on the tree-top or sprawling about, with many an amusing antic, near the foot of the tree. However, with the tying of the pot the tapping-proper begins and, for a couple of days thereafter, every morning and evening, the tapper, on emptying the toddy-pot into a curious bucket which is carried strung to his waist, trims the ends of the spikes with a sharp, broad-bladed, little chopper, with which, on each occasion, he carefully slices off about an eighth or a quarter of an inch of their length. After this, the spikes are untied and rolled about between the palms for three, four or even five days. They are then tied together again and tapping goes on, without interruption, for five days. By this time, the yield of toddy would be about four quarts per day. The spikes are now untied, rolled for three days and bound together again. The tree is then tapped for eight consecutive days when, a yield of six quarts per day being attained, the rolling of the spikes again goes on for three days. Another twelve days of tapping, enhancing the yield to eight quarts, ensues, and the spikes are then pressed for three days. This pressing is a repetition of the first operation only, when undertaken at this stage, it is done more thoroughly. The tree is then tapped again for twenty days, at the end of which time the yeld will have run up to twelve quarts. But when, a few days later, it shows symptoms of decline, the spikes are once more, and for the last time, vigorously squeezed, twisted and rolled about for three days. This sustains the yield of toddy some time longer and, in strong, healthy individuals even increases it to eighteen or twenty quarts per day. But the course of the spathe is run. Through the frequent slicing of its lower end it will, by this time, have been reduced to less than half its original length; and when, after a month or a month-and-a-half more of tapping, the yield of toddy steadily declines until it at last ceases, all that will remain of the once beautiful cluster of graceful, light-green spikes would be but a few inches of their dry and shrivelled-up stumps.

When tapping is going on in any particular spathe, the others do not so readily emerge, but, varying from a fortnight to a couple months after it gives over, one or more of them appear. Sometimes several come out in quick succession but, then, they are tapped, each in its own proper season: in this way, three or even four spathes may be all seen tapped on the same tree, at one and the same time. When such prolixity is evinced, however, the last spathes are slow in appearing, but, again, when they do emerge, they are generally more vigorous than the ones gone before. In any case, the last spathe is the smallest and it, like the first, is usually let alone. Again, owing to the extremely vigorous condition of certain individuals, it sometimes happens that the flow of toddy is so copious that the pot has to be watched and emptied several times during the day. It is also interesting to note that some

spathes, in spite of the most careful and exciting training, will not yield any toddy whatever.

An average-sized spathe is tapped in about four months, and it usually takes about two years for all the spathes of a tree to be tapped.

As the toddy is taken down fresh from the trees, it is sweet, and fairly large quantities of it may be drunk without fear of inebriation. It is not only mild, but is considered both wholesome and nourishing—hundreds of poor little Poolaya and Choga babies being kept upon it throughout the day while their mothers are working in the fields far away. Unlike the cocoanut's, the toddy of the Caryota is thin, *i. e.*, more watery; but once fermentation sets in, it soon turns into a foaming, beer-like liquid, acid to the taste and intoxicating readily. It is this strong, sour toddy, however, which diluted with water, is usually drunk by the lower classes, especially the Poolaya who would refuse to take any other, even the sweetest: but give him the sourest, and he would, calling it "Nalla poolicha Kallu" (good sour toddy), drink as much as four or five quarts at a single sitting in one of his thirsty noon-day palavers.

Tapping for "Jaggery" is conducted on the same principles as tapping for toddy, only the pot used for "Jaggery-toddy" is thickly coated inside with well-slaked lime which stays fermentation for several hours. On being collected this toddy, which is very sweet, is poured into large copper vessels and boiled down for several hours, until it grows into a thick, dark brown, syrupy, granular mass, when it is ladled out into little brass or earthenware dishes and, solidifying on cooling, constitutes the coarse native sugar familiarly known as "Chakkaray" or "Jaggery".

KOOTHATOOKOLAM
28th January, 1895.

A. M. SAWYER.

The Sandalwood tree in Mysore.

Sandal-wood *(Santalum album)* belongs to the Santalaceæ family. It is a tree with fragrant wood, opposite entire smooth leaves, of a roundish oval shape and of a dark green colour. It propagates itself in Mysore amongst bushes, woods and rocks. The tree is a middle-sized one, and has a good crown. It is almost peculiar to Mysore and Coorg, and though it grows to some extent in some of the adjoining districts of Madras, it is comparatively less in quantity and inferior in quality. Though the tree is found all over Mysore it grows very unequally in different parts

of the country. It is not met with in the heavy, evergreen forests, and is conspicuously absent to the west of Hemavati towards South Canara. It attains its greatest bulk and weight in places with a moderately heavy rainfall, say 30 in., but the perfume of the wood grown in such localities is not so strong as that of trees grown in more arid spots. The girth of a mature tree varies according to soil and circumstances, and in exceptional cases there are trees with 4 to 5 feet in girth, with a stem of 16 ft. long to the first fork. It attains maturity at between 20 and 40 years of age according to soil and climate. The older the tree the nearer the heartwood comes to the surface.

The tree is found in three varieties, red, pale and yellow, but they exhibit no indications externally, and there are two other sorts of sandal, called Navul Kannu (pea-fowl's eye) and Naga Kannu (cobra's eye), so-called on account of some spots on the heartwood, which can be distinguished by a careful observer by the external condition of the bark. The heartwood is hard and heavy, highly scented and rich in oil, the bark and sapwood have no smell. The best parts are used for carving boxes and other works of ornament This is probably the most valuable of woods in the world, for the market value of a cubic foot of it varies from Rs. 10 to Rs. 20. The roots, which are the richest in oil, and the chips, go to the still. It forms the basis of many scents, and is also used in medicine. By far the greater portion of the wood sold yearly in Mysore is taken to Bombay, the annual revenue to the Mysore State from Sandalwood varying from 10 to 14 lacs of rupees. The Mysore Government have long established Kothis at different centres of the Province, for the storage of Sandalwood collected from the forests and other lands, where it is prepared and exposed annually for sale. Dead and dying trees, and fully mature trees are removed bodily, and the bark and sapwood are taken off in the forests. The wood is then carted to the nearest Kothi. In the Kothi, the root of the tree having been first separated from the stem by a saw, the log is cut into billets of 3 feet in length, any white wood that might have been 6 feet on it is removed by a small adze and then chipped, The billets going into the first five classes are then planed either with a carpenter's plane, or shaved with a double-headed bill hook, to give the billets a smooth surface. The wood is classified by the weight of the 3 feet billet and its external appearance. The wood is generally assorted into 12 classes, the first 5 classes, then the roots, *Jujpokul* (or hollow wood) *Bagar Adeidor* small pieces, *Hutri*, *Iyu* and *Milwa Chilias* and the saw powder. The rules for the classification of wood framed by the late Dewan Purnaiya are almost fully still in force.

Although Mr Petrie Hayes has been bringing about improved machinery for the extraction of Sandalwood oil, the primitive mode of obtaining this oil by distillation is still in vogue, and largely

followed by people in South Canara. It may be interesting to many of the readers of the *Forester* to know the details of the primitive method of distilling Sandal oil. To say briefly, Sandal oil is procured by distillation, the roots yielding the largest and the finest quality of the oil The body of the still is a large globular claypot, with a circular mouth. The mouth of the still, when filled, is closed with a claylid, having a small hole in the centre, through which a bent copper tube is passed for the escape of the vapour. The lower end of the tube is conveyed inside a copper receiver placed in a large vessel containing cold water. When preparing Sandal for distillation the white or sapwood is rejected and the heartwood is cut into small chips, of which about 2 maunds or 56 lbs. are put into the still. As much water is then added as will just cover the chips, and distillation is slowly carried on for 10 days and nights, by which time the whole of the oil is extracted. As the water from time to time gets low in the still, supplies are added. The quantity of oil yielded by wood of good quality is about 10 oz. per maund. The oil is transparent, and of a pale yellow colour.

Propagation.—It is understood that the formation of Sandal plantations in Mysore was first mooted at the beginning of the present century by Colonel Wilks, then acting British Resident in Mysore. At that time the universal opinion that existed appears to have been that Sandal trees would not thrive in artificial plantations. Nurseries of Sandal plants were made and the plants transplanted into pits, but this was attended with failure. Mr. Ricketts, the Inspector-General of Forests in Mysore, in his circular regarding Sandal growth, says that artificial planting in the open, even on the most favoured soils, is generally attended with failure for want of shade to the seedlings in the hot season, but that the chances of failure of artificial sowing in ploughed lands have proved to be few and limited. All that is required to be done is to select a good sized block of waste land favourably situated, if possible, as regards moisture, though if the soil be poor it does not much matter. This block of land should be thoroughly ploughed at the first rains or the usual ploughing season. Sandal seed should be sown at the ordinary sowing season mixed with seeds of quick growing indigenous fuel trees or any naturally quick growing trees. Experience has shown that this method of planting Sandal is a success, and a plantation worked on it in the Gundekutte Kavul, close by Hassan, has a hundred thousand young Sandal trees. Doubts are expressed as to whether artificially sown Sandal trees would produce Sandalwood, equal in scent to that grown spontaneously, but the plantations are young as yet, so that it will take time to remove the doubt.

N. NARAYAN RAO,

Forest Ranger, Hassan

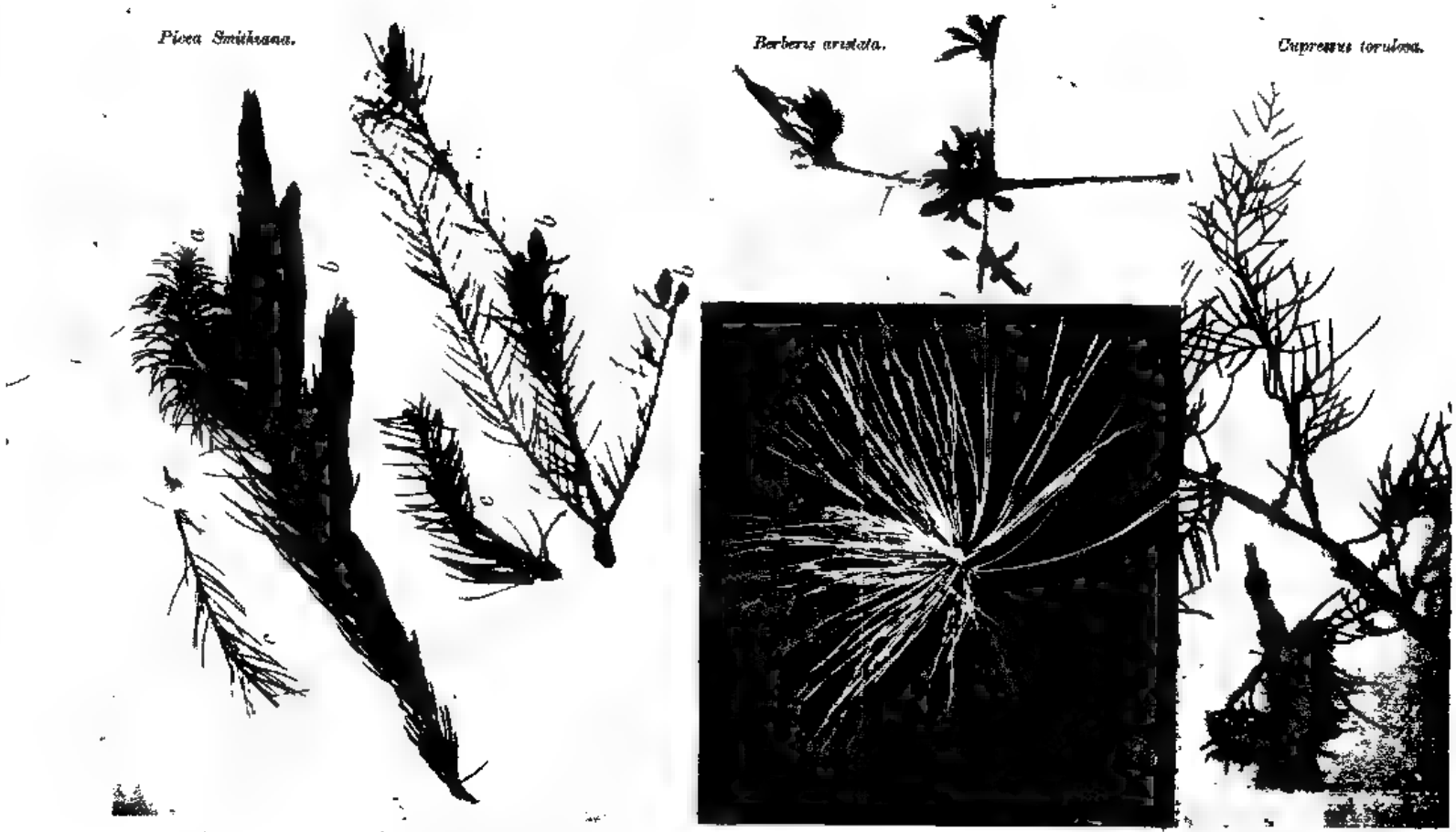
The Management of Forests containing teak.

The review of the Annual Forest Administration Report for Mysore for 1891-92, which appeared in the February issue of the *Forester*, shows that in Mysore as on the Anaimalai Hills, the same difficulties are experienced with regard to the reproduction of teak, and of the few valuable species which the mixed forests contain. Immediately the leaf canopy is broken, a rank undergrowth springs up, and the teak seedlings stand no chance. It would be interesting to know whether the same conditions obtain in Wynaad, Travancore and Cochin. Personally I feel convinced that the selection method of treatment, and fire protection, unaccompanied by cultural operations, is not sufficient in the mixed forests of Southern India, which still contain teak, and that if the present system continues, teak, rosewood and vengay, (*Pterocarpus Marsupium*) and other valuable species will become extinct. I drew attention to this fact last year in the *Forester*, and suggested certain remedies; the subject is, however, of such vital importance, that I again refer to it, in the hope that other foresters may give us the benefit of their experience and advice. The Nilambur plantations (Malabar district) have, I believe, always been looked on as a source from which, in the future, considerable supplies of teak will be available. The growth of teak in these plantations is doubtless very rapid, but it yet remains to be proved whether teak, grown on these alluvial deposits, is of the same quality as teak grown on the Anaimalais and other hills between 1,000 and 3,000 feet above sea level. Soft, spongy teak is of less value than good, sound jungle-wood of inferior species. I have had no experience of the Nilambur plantation teak timber, but as I found that the Anaimalais teak required, on an average, 120 years, to attain a diameter of 2 feet, I am inclined to be suspicious as to the qualities of the Nilambur teak, with its rapid growth. However, I am doubtless prejudiced on the subject, and Mr. P. Lushington, who is now engaged in preparing working plans for the Nilambur plantations, would be able to enlighten us on the subject. I visited the Nilambur plantations in 1887, and was much struck with their appearance; on the whole I was disappointed, many of them had not been sufficiently thinned, and the consequence was that the trees in some of the older plantations had poor crowns, and resembled telegraph posts; thinning was urgently required, but it was doubtful whether it could be undertaken without serious risk at the time: in any case it was an operation which required extreme care, as the trees could have had but little root, and if the wind once got in they would have gone down like nine-pins. What has been done since then in the plantations I have never heard, and it seems a pity that there is no annual record of how our forests are worked in each district, and what are the results of cultural operations, &c., &c. Had there

been any system of collecting such information as is the case in other countries, an Indian sylviculture might have appeared, accompanied by a treatise on working plans for different kinds of forests long ere this. True, we have the Code Forms and Returns, but they are useless for the purpose. For 40 years at least the Anaimalai hills have been under the management of the Forest Department, during which period a large quantity of timber has been worked out, but as the problem of teak reproduction has not yet been solved, the forests must have become poorer every year, and this is doubtless the case elsewhere; far too much importance is attached to financial results. As natural forests of pure teak do not occur at any rate in Southern India, it is more than doubtful whether plantations of pure teak on alluvial deposits are likely to produce first class timber. At the time (up to 1887) there was a good demand for teak poles from Nilambur, these were, I believe, sent up the Persian Gulf; if this demand still continues, and if it be found that the timber is inferior, there is every reason why the Nilambur plantations should be worked solely to meet this demand. If, on the other hand, the timber is of good quality, the plantations should be worked as timber forests, as the thinnings will probably meet the demand for poles.

It is unfortunate that the conditions at Nilambur are peculiar, and obtain nowhere else in Southern India so far as teak is concerned, as the data now being obtained, interesting as they doubtless are to show how rapid is the growth of teak in the Nilambur plantations, will not be of the slightest use in constructing tables for the preparation of working plans for any other forests. In such regular plantations the possibility might be fixed at so many trees a year, without attempting to determine the annual volume to be felled.

TRICHINOPOLY,
5th March, 1895. } H. J. PORTER.



FROM PHOTOGRAPHS TAKEN BY C. E. ROGERS, ESQ., DEPUTY CONSERVATOR OF FORESTS, IN JAUNSAR IN APRIL AND MAY 1904.

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Note on the Cultivation of the Robinia Pseudo-Acacia in the Simla Hills.

For some time past more or less extensive experiments with the Robinia have been carried on in the neighbourhood of Simla, and the following notes on the treatment successfully adopted may be of interest to some of the readers of the *Forester* :

Direct sowings have been tried again and again on various aspects, at different elevations, and during different seasons, but have failed completely in all cases, and so it appears certain that the plants must be raised in nurseries.

It has been found that sowings made in the beginning of the rains were not very successful, as the amount of moisture that they then experienced was apt to kill off the seedlings : the best time then for the necessary sowings, which should be light, is from the middle of September to the middle of March, according to the altitude, and this is equivalent to saying that the seed can be sown as soon as there is no further danger to be apprehended from frost. Drainage is the main point to be seen to in the construction of the nurseries, for an excess of water, but more particularly anything in the shape of stagnant water, is fatal to the young seedlings ; the nurseries should therefore be made with small raised seed beds surrounded by small trenches, and the amount of water given during the hot weather should be regulated by the appearance of the plants, care being taken to avoid any flooding of the nurseries, and to see that no water remains standing in the beds. The seedlings commence germinating some three weeks after the sowings, and grow quickly, many of them attaining a height of over two feet by the break of the rains and of over five feet by the end of the growing season, while exceptionally quick-growing specimens have been found to attain a height of eight feet six inches during this period : seedlings germinating late will naturally become more or less suppressed, but, nevertheless, it is inadvisable to attempt any rebedding during the rains, for this stops the growth of the larger and kills many of the smaller plants that are moved. Similarly to the sowings, the results of transplanting from the

nurseries during the rains are not very satisfactory, and it is better to do this work during January and February, timing it so as to give the plants the benefit of the latter portion of the winter rains after they have been placed in their final situation. At first, plants of all sizes were put out into the plantations, but it was noticed that the smaller ones made very little progress during the first and sometimes also during the second year following their removal, while the large plants grow on without any such break: now, therefore, no trees under three feet six inches in height are used for transplanting, and all under these dimensions are rebedded into nurseries during January and February, and left there for another year.

This transplanting and rebedding cannot be done without inflicting some injury on the roots, but, with the Robinia, this really does not matter; indeed, it is found that, while the transplants themselves do not suffer, the bits of the roots *inadvertently* left in the ground give rise to a crop of flourishing root suckers during the following year, and these attain larger dimensions than the seedling plants.

The formation of regular plantations has only just been commenced, so that it is not possible to give statistics for the growth of the species when cultivated in this manner; but an individual tree has been known to attain a height of over 20 feet and a girth of one foot four inches below the first branch, in three years from the sowing of the seed; again, in a small plot at Jutogh, stocked in the winter of 1892-93 with one year old plants of all sizes, put about ten feet apart, the trees, many of which are now from 10 to 13 feet in height and 6 to 13 inches in girth, bore seed last year, and have commenced to throw up root suckers. It is believed that six feet by ten feet is a good espacement to adopt for the trees in plantations. Nothing very definite can yet be said on the subject of suitable altitudes and aspects, beyond that the experiments made up to the present appear to show that the species will grow almost anywhere between 4,000 and 8,000 feet, and that it will possibly do equally well at lower elevations; also that it has no particular objection to hot aspects, and seems to like loose friable soils. As regards the cost it may be noted that in Simla, where the work has been longest established, the total expense is just about two rupees for every hundred plants put into the plantations, and this, at the six feet by ten feet espacement, means an expenditure of under fifteen rupees for an acre of plantation, which is not very much when it is remembered that there is little or no further cost to be met for repairs, as, once through the first season in the nurseries, the species is wonderfully hardy, and gives no trouble. Many thousands of *Robinia* have now been put out at various elevations and on various aspects in Simla, Jutogh, Dagshai and Sabathu, and where the large plants only were used, the failures met with have been very few indeed.

G. S. HART.

Forest Demarcation in South Arcot.

Forest demarcation as now conducted in the Madras Presidency may be divided into 2 classes, *viz*, I.—Preliminary and II—Final.

I.—Preliminary Demarcation.

Definition:—This, as its name indicates, simply means defining on the ground by means of temporary marks the outer limits of forest blocks that are newly selected for the purpose of reservation. According to the recent orders of the Madras Government, every forest block must be *preliminarily demarcated* before it is notified for reservation under Section 4 of the Madras Forest Act.

Method adopted :—The method adopted in South Arcot District consists in cutting a line 6 feet wide along the boundaries intended to be notified under Sec. 4, and constructing stone-cairns or earth-mounds at all turns or bends in the line.

In order to carry out the preliminary demarcation of a forest block accurately, the officer conducting the work provides himself with a sketch-map of the block, on which are indicated not only the topographical features of the land and its surroundings, but also the Revenue Survey stones of the various fields, forest Khandams, and other areas that may be comprised in the block. Of course the boundaries of the block are also indicated on the sketch-map. With this sketch in hand the demarcating officer starts his work generally from the north-west corner of the block where he plants a flag. From thence proceeding eastwards he goes on fixing a flag at every angle in the boundary lines until he comes back to the starting-point. To minimize chances of mistakes by workmen, in case of any flags being removed by wayfarers or cowherds, he generally marks in tar R. F. and the serial number of the flag on Survey stones, trees, or any permanent object that may be found near the flag.

Construction of Stone-cairns or earth mounds :—Soon after *progress is made in fixing the points by flags*, a guard follows the demarcating officer, with a gang of coolies, and constructs a stone-cairn or a mound of earth, which is usually 3 feet high and 3 feet in radius, at every flag-point.

Line-clearing:—As soon as all the points on the boundary line are defined by cairns, or, in fact, simultaneously with that work, the cutting and clearing of the boundary line is commenced. The line is cut perfectly straight between any two adjacent cairns to a width of 6 feet. The outer edge of the cut line will be along the line of Revenue Survey stones should the line follow such stones, but in cases where it does not follow such stones, along the outer edge of the consecutive cairns.

Cost of preliminary demarcation:—From experience gained in some ranges of the District, it is ascertained that the average cost per mile does not exceed, Rs. 2-8-0 both for line-clearing and

construction of cairns. It is found that where stones are available near at hand, a cairn costs about one anna, and a mound of earth about nine-pies. Of course, the cost is dependent upon the density and description of growth to be cut, prevailing rates of wages, proximity of the requisite materials, and so on. But it should always be borne in mind that preliminary demarcation is, after all, temporary, and that it should therefore be conducted with all possible economy, utilizing the materials nearest to hand in order to secure marks that last sufficiently long to ensure identification of the boundaries until the final demarcation of the block is taken in hand.

II.—Final Demarcation.

Definition:—The term "Final Demarcation of a forest" means the defining of the boundaries finally determined upon after Forest Settlement and Notification under Sec. 16 of the Madras Forest Act, by the use of permanent marks such as stone slabs, masonry pillars or substantially constructed cairns; and by cutting a line all round. It also includes permanent demarcation of all admitted private or public rights within the forest by similar means.

An accurate map necessary:—Before commencing this work, the officer conducting it provides himself with a sketch-map on which the outer boundaries of the block as well as all admitted rights of way, water courses, burial grounds, puttah lands, &c., are correctly indicated. The accuracy of the map is previously verified by a careful comparison with the description of the boundaries and the various admitted rights published in the final Notification under Section 16 by Government. The best course to pursue is to obtain the original sketch map submitted to, and approved by, Government when the block was notified under Section 16, and in case it is not available, to secure an exact copy of it. With this map in hand, the Ranger himself, or an experienced Forester who has the requisite local knowledge of the block, proceeds with its final demarcation.

The final demarcation of a forest block includes the following items of work:—

1. Demarcation of the outer boundaries,
2. Demarcation of admitted puttah land,
3. Demarcation of admitted paths, and
4. Demarcation of other admitted rights, such as temples, burial grounds and so on.

For the sake of convenience and clearness, I propose dealing with each of these items separately:—

I. *Demarcation of the outer boundaries.*

This comprises the following—(*a*) Blocks preliminarily demarcated; and (*b*) blocks not preliminarily demarcated.

(*A*)—In the case of preliminarily demarcated blocks, their final demarcation is necessarily an easy task. Here again, it may comprise (*i*) blocks, the original boundaries of which re-

mained unaltered at Forest Settlement; and (*ii*) blocks the preliminary boundaries of which were altered at Settlement.

(*i*) Taking the first case, if no alteration was made at forest settlement in the preliminarily demarcated boundaries of a block, *then all that is required to be done to finally demarcate it is simply* to replace the temporary cairns by permanent stone slabs or substantial cairns of stones with posts inserted in their centre as described lower down; to add as many intermediate stone slabs as cairns with posts as may be required to render them distinctly visible from those on either side; to widen the already cut 6 feet line into 12 or 18 feet as the case may be; and to eradicate all stumps and roots on the line as described below.

(ii) Taking the second case, the originally erected temporary cairns on the unaltered lines are replaced by permanent stone slabs or cairns with posts; and the same process is followed in respect to altered lines, care having been previously taken to indicate the points on the line selected to ensure continuity of vision from one slab to the other.

(B)—In the case of blocks not preliminarily demarcated much difficulty is experienced in practice in *finally demarcating* them, *there being nothing on the ground to guide the demarcating* officer in identifying the correct boundary lines, especially so in the case of blocks the boundaries of which are notified in vague, and indefinite terms, as instanced in the case of a few Reserves settled prior to the year 1890, in which, owing to the vagueness of the descriptions of their boundaries, much difficulty was experienced in identifying them on the ground, and therefore much attention and discretion is called for on the part of the demarcator. Thus *we have here, too, two cases to deal with (1) that in which the* boundary descriptions notified are clear and lucid and (2) that in which the descriptions are vague and indefinite.

(i) In the first case the demarcating officer proceeds to the fields with a sketch map of the block on which the boundaries are previously marked, as notified under Section 16 of the Forest Act, and starts his work at the north-west corner of the block. He plants a flag at the starting point and numbers the Survey field stone, a *tree, or any permanent object near that point with No. 1* in tar, and proceeds planting flags at visible distances apart on the line and marking the consecutive number of each flag on any permanent object close by, care being taken that the line followed is strictly in accordance with the notification. Should any difficulty or doubt arise, the village officials of villages in which the forest lies are taken to the spot, and all doubts cleared before proceeding further. As above stated, the distance between any two *consecutive flags is so regulated* as to admit of their being distinctly seen from each other, and of course, at every turn in the line

a flag is planted. In this manner flags are planted all round the block, and their exact positions marked on the sketch.

(ii). In the second case where boundaries are described in such vague terms as "along the foot of Alampundi Hill" or "cultivated fields of Kristnapuram village," the demarcating officer has to be more careful than in the above case. A sketch-map of the block is prepared by taking a tracing from the Revenue Survey plans of villages concerned, and with this map in hand the demarcator goes round the block indicating the boundaries on the map as he finds them on the ground. As far as possible he takes straight lines for boundaries wherever he can do so without excluding forest land and without including private pattah holdings. To do this efficiently and correctly he may have to go over the boundaries more than once, the work thus entailing much patience and attention. After indicating the boundaries on the map, it is submitted to the District Forest Officer with a detailed explanatory note of any areas excluded or included in order to straighten the boundaries consistent with the terms of the boundary description notified. After receiving the District Forest Officer's orders thereon, the demarcator proceeds to fix flags at all necessary points on the approved boundary lines as described in the first case. The information required for the demarcation of admitted rights, such as puttah lands, paths, &c., is ascertained by inspection and marked on the sketch map.

Submission of Estimates for Final demarcation

As soon as flags are fixed all round the block and information collected for demarcation of admitted rights, the demarcator who is then in a position to know the number of stone slabs or cairns and posts required for the outer boundaries and admitted private and public enclosures, &c., in the block, prepares an estimate. The estimate provides for the cutting and clearing of the boundary lines to a given width, say 12 feet, and for putting up stone slabs, or cairns and posts, as the case may be, on the outer boundaries, and at the corners of admitted rights. The estimate is submitted to the District Forest Officer with a sketch map, on which are marked the boundaries and the points selected thereon for planting stone slabs or cairns and posts, and also the various admitted rights. The estimate is also accompained by a record of the points selected for planting stone slabs, &c. After intimation of sanction of the estimate is received the work is put in hand.

As elsewhere remarked, the final demarcation of the outer boundaries consists of two distinct items of work:—(1) Line clearing and (2) planting stone slabs or cairns with posts at all the flag points.

(i) *Line clearing.*—This work is commenced by the Range officer, or by an experienced Forester with the forest guard

in charge of the block. At the required width apart from the first flag another flag is planted inwards, similarly a separate flag near the next flag at the same width apart is planted. These flags enable the workmen to cut the line straight between any two points and to a uniform width. A gang of coolies is set to cut and clear the line ; as the work progresses, the flags are shifted forwards. All trees, shrubs and herbs on the line which is generally 12 feet wide in South Arcot are cut and removed, and all roots and stumps grubbed up and eradicated thoroughly to ensure freedom from re-growth on the line. After conducting the operations in this manner for a day or two and instructing the guard in the nature of the work to be done, the Range officer or Forester will leave the guard solely in charge of the work. The guard continues and completes the same within a given time.

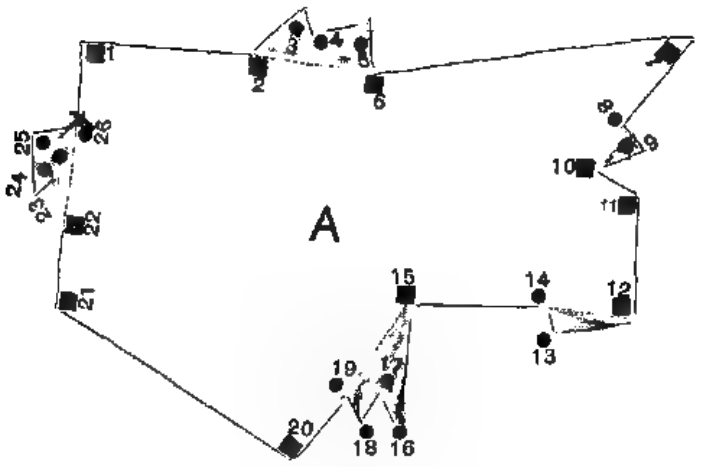
(2). *Planting stone slabs, or constructing cairns with posts.*—Immediately after the boundary lines are cut and cleaned, or simultaneously with the progress of that work, the planting of stone slabs, if available, or the construction of cairns with posts inserted in their centre at all the flag posts is proceeded with.

Stone pillars.—On account of their durability, freedom from frequent damage, necessity for repair, or renewal, stone slabs are preferable to other materials as boundary marks.

Dimensions of Stone slabs.—The following are the sizes in general use in this District—8 ft. or 6 ft. high by 1 ft. broad by 4 to 6 in. thick and 5ft. or 4 ft. by 1 ft. by 4 to 6 in., the former being, for convenience of description, called *large slabs*, and the latter *small slabs*. The height of the stone slabs required for the demarcation of any block depends very much upon the configuration of the ground, and the distance of the Reserve from the quarry, as it naturally follows that the bigger the stone slabs the higher the cost of carriage. But for all main points on the line, slabs of 8 ft. or 6 ft. are utilized.

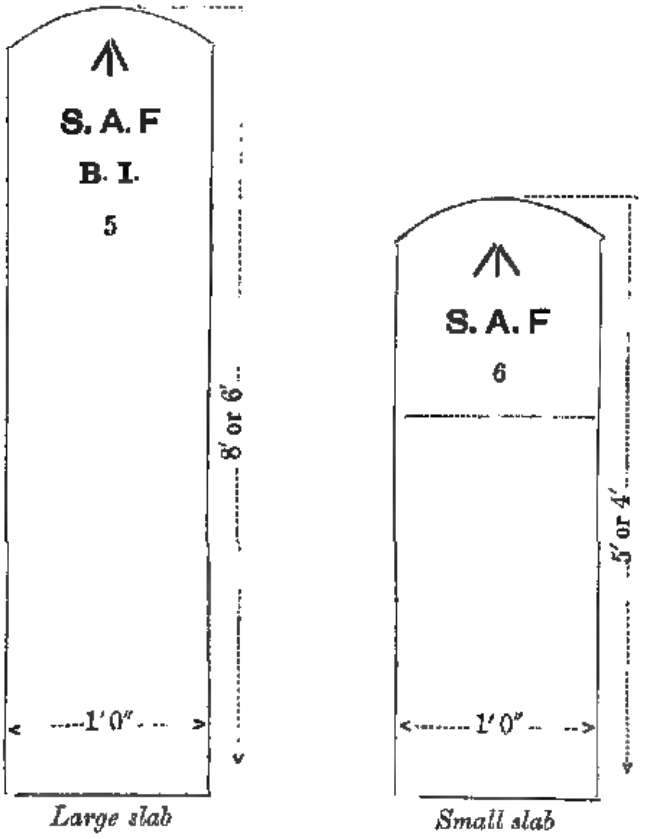
Disposition of stone slabs on the Boundaries.—At each point on the line at which a flag had been fixed, as already described, a stone slab is planted. Large stone slabs are planted at all conspicuous points and turns in the boundaries and the small ones at all minor bends and angles. The object of this distinction is simply this, that when it is sought to cut straight lines at the time of regularly working the Forest, these large stones may be seen at the ends of the straight end lines, the limits of the small areas excluded in consequence of straightening the lines being defined by

the small slabs. The diagram given below illustrates what is meant by the above;—



Let the above diagram A represent a forest block with an irregular boundary. The mark ■ represents a large stone slab and ● *a small one. The dotted lines indicate the straight lines* adopted in order to simplify and straighten the boundaries for convenience in working the forest. Between stone slabs 2 and 6 the line is irregular, resulting in several small angles. If a straight line is cut from 2 to 6 a small area enclosed by 2, 3, 4, 5, 6 and 2 is included, although it forms a part of the notified Reserve. Therefore in order to indicate that it forms a part of the block, small slabs are planted at the minor angles 2, 3, 4 and 5. Of course large slabs may be planted at these minor angles as well ; but it is only the question of cost that suggested the adoption of small stones.

Inscription on stone slabs—The large stone slabs bear the following inscriptions:—Government arrow mark ⩚, the District Forest initials S.A.F. (South Arcot Forests), the number of the block, and the serial number of the stone slabs. The small ones bear all the above inscriptions except the number of the block. The tops of the slabs are rounded, and the figures and letters cut out in them after smoothening the surface. The diagrams below show the manner in which the inscriptions are written.

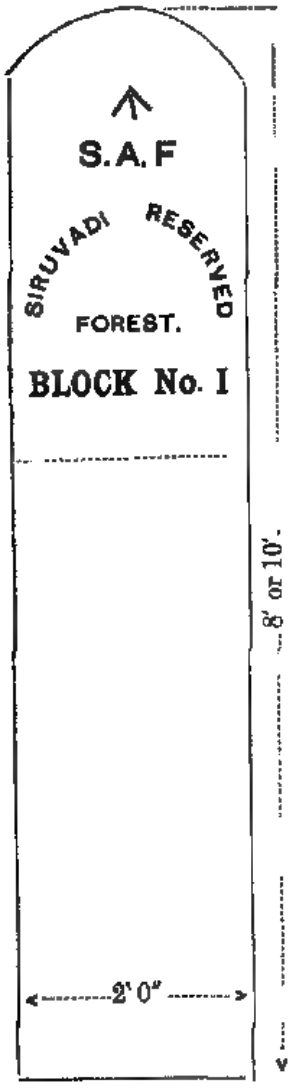


Large slab *Small slab*

The initial letters of the District Forest are adopted only in the Tindivanam Range ; in other ranges the letters R. F. are used instead. The stone slabs are numbered serially irrespective of their sizes, a separate serial order being adopted for each block.

Planting the Stone-slabs:—In planting the stone slabs they are always so arranged as to have their numbered sides facing outwards, that is, away from the Reserve. Large slabs are planted

generally 2 feet deep in the ground, and small ones 1½ feet deep. They are firmly fixed, with earth and small pieces of stone well rammed in.



Planting the slabs:—The numbered top portions of the slabs are painted white. It is found advisable to paint the tops all round to a length of 2 or 3 ft. so as to enable the stone to be easily seen. The chiselled letter and figures are picked out in black.

Sign posts indicating names of Reserves, &c:—The Board of Revenue has ordered that a board indicating the name, number, &c., of each block should be put up at some conspicuous point on its boundary. In lieu of a wooden plank fixed on to a post which requires frequent repairs, a large and broad slab bearing the necessary particulars is used wherever such slabs are procurable. In Tindivanam range slabs 10ft. or 8ft. × 2ft. × ½ft. bearing the ⩚ mark, S. A. F., name of Reserve and its number are used. The figure given below represents a slab of this description.

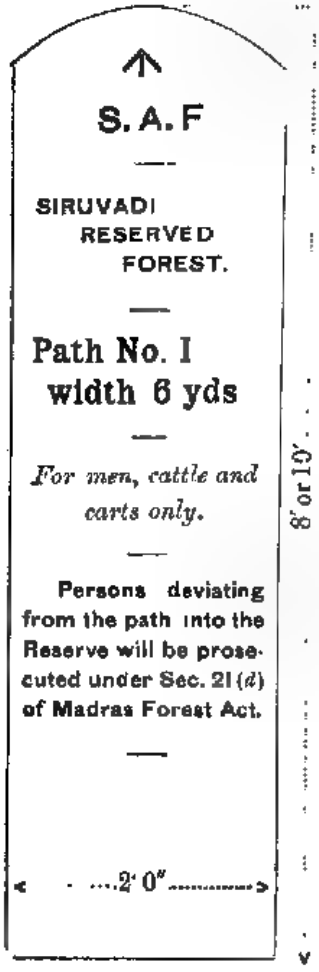
2. *Demarcation of admitted puttah lands.*

This is simple, a line 3 to 6 ft. wide is cut round the limits of the admitted fields, and small stone slabs (5 ft or 4 ft. × 1 ft. × ⅓ ft. to ½ft., are planted at all the corners of each field. The slabs bear the ⩚ mark S. A. F., with or without the letter P, which is used to denote puttah land. In case of fields which are cultivated over their whole extent, cutting a line is dispensed with as the verge of cultivation itself and the stone slabs planted at the corners are sufficient to define the limits of such admitted private enclosures.

3. *Demarcation of admitted Rights of Way.*

All admitted footpaths and bandy-tracks have also to be demarcated or defined in order to enable the public to know the

admitted rights of way within the Reserve. For this purpose two stone slabs at the entrance of an admitted path into the Reserve and 2 at its exit are put up at the admitted width apart, one of the two slabs is 2 feet broad, while the other is 1 ft., and both are 10 or 8 ft. high. The broader slab bears the name of the Reserve, the number and width of the path, the purpose for which it is admitted, and the penalty for deviation from it; and the other slab simply bears the ⅄ mark and S. A. F. The inscription is written in Tamil, and is cut out in the stone. Where broad slabs are not procurable, narrow ones are used indicating the number and width of the path.



4. *Demarcation of other admitted Rights.*

The limits of other admitted public or private rights within the Reserve are defined in the same manner as those dealt with in the preceding cases with such alteration and modifications as the peculiarities of each case may necessitate.

Cost of Final demarcation:—It will not be out of place to give where details of cost actually incurred in demarcating some of the forest blocks in South Arcot. As I am best acquainted with the work done in Tindivanam Range, I shall confine myself to the figures recorded in that Range. The following statement shows the details

of cost of finally demarcating the forest blocks in Tindivanam Forest Range.

Statement of cost of final demarcation of 10 Reserved Forest blocks in Tindivanam Taluq of South Arcot District by cutting and clearing boundary lines and planting stone slabs.

No.	Name of Forest Block	Total length of boundaries	Total cost of line clearing and grubbing out roots and stumps			Average cost per mile of line clearing			Details of stone slabs put up: For outer boundaries	For admitted pattah lands	For admitted paths	S. slabs brg. manes, &c.	Total No. of slabs	Total cost of putting up stone slabs including carriage, numbering planting, &c.			Average cost per mile of stone slabs calculated on the outer boundaries			Total of the cost of line clearing and stone slabs			Average cost per mile of demarcation (line clearing and slabs)			Remarks
		Miles.																								
1	Siruvadi ...	15½	175	12	9	11	5	6	169	93	3	2	267	157	4	9	10	2	4	333	1	6	21	7	10	
2	Muttakadu ...	10½	96	6	9	9	2	11	80	14	0	2	96	64	4	0	6	1	11	160	10	0	15	4	10	Some additional stones have since been planted at minor turns.
3	Karai ...	8¾	69	2	3	7	14	5	94	28	...	1	123	73	5	6	8	15	3	147	7	9	16	13	8	
21	Kumalampattu ...	9½	Nil			Nil			101	16	17	...	134	88	6	6	10	6	5	88	6	6	10	6	5	Produce cut on the line was given away in lieu of wages.
22	Kil Sevur ...	6⅛	Nil	..		Nil			84	17	4	..	105	57	5	3	9	5	9	57	5	3	9	5	9	Do. D
25	Peradikuppam	6¼	44	0	0	7	0	8	64	0	4	1	69	64	14	6	10	6	2	108	14	6	17	6	10	
26	Akkur ...	8¼	68	9	6	8	5	0	74	0	8	1	83	64	1	9	7	12	4	132	11	3	16	1	4	
28	Saram ..	4½	28	4	3	6	4	6	48	60	11	1	121	82	9	0	18	5	7	110	13	3	24	10	1	Cost of line cutting was partly met by giving produce on line in lieu of wages.
19	Kurumbaram 1st Bit .	7⅓	22	13	3	3	3	3	168	58	8	0	234	152	12	4	21	7	1	175	9	7	24	10	4	
24	Venmaniyatur ..	5¾	36	...	9	6	4	4	99	34	11	2	148	93	3	0	16	3	3	129	3	9	22	7	7	
	Total ...	61¼	541	1	6	6	10	7	..	...	...	...	1378	903	2	7	11	1	0	1444	4	1	17	12	5	

It will be noticed from the foregoing statement that the cost of clearing boundary lines and of procuring the stone slabs varies largely in different blocks. This is due to several circumstances, the chief among which are (1) variation in the density and description of forest growth, (2) difference in local rates of wages, (3) distance of stone quarries from forests demarcated, (4) availability of stone masons, (5) straightness or tortuousness of boundaries, (6) the number, extent, and the shape of the periphery, of admitted enclosures and so on. On the whole considering the permanent and substantial nature of the work Rs. 17-12-5 per mile of final demarcation on this method is certainly most reasonable.

As I have far exceeded the limits which I originally proposed to myself in writing this article I shall put off giving a brief description of the *post and cairn method* of final demarcation to a future date.

M. R.

TINDIVANAM,
14*th January*, 1894.

Note on the Extraction of Timber by Government Agency, in Burma.

When teak trees have been girdled full three years the Forest Officer has to arrange for their extraction, and in forests where no trees have been girdled, or the girdled trees have been extracted, there is always a quantity of dead and fallen timber, and it is the duty of the Forest Officer to bring this timber also to market as quickly and with as little loss as possible.

2. The distribution of this work among the different contractors is in some divisions the most important work of the year and the one which calls for the greatest exercise of judgement and a thorough acquaintance with his forests on the part of the Divisional Officer. In this paper it will be impossible to give the Forest Officer a complete set of instructions to guide him, but it is hoped that it will contain so much advice and so many hints that he may not make any great mistakes even when he finds himself in a new division where the forests and contractors are both strange to him.

3 Contracts are usually given out annually, and in November, when it is known how many logs the old contractors have left lying in the forests or neaped in the streams. Before distributing the work the Forest Officer should be master of full information on the following points.

(*a*) The number and locality of girdled trees which were girdled more than three years ago, but have not yet been felled.

(*b*) The number and locality of trees girdled three years ago and which are now ready for extraction in the ordinary course of events.

(*c*) The number and size of the elephants belonging to each contractor.

(*d*) The balance of logs left by each contractor and how many of them are lying in the forest and how many are neaped in the streams.

4. Experience has taught us that the best work is done by contractors who have at least three elephants, for this number enables a contractor to divide his forces during the rains and to take advantage of every rise in the streams. In the case of the man with

one elephant the animal is usually employed in launching logs in the floating streams or pushing down the smaller streams at a time when all logs previously launched are stuck in an obstruction miles down the stream, and the result of this often is that all or a large proportion of the logs felled by such petty contractors are neaped and left for next floating season. Of men with three or more elephants the best contractors are those with the most powerful elephants; in the case of old contractors the Forest Officer can easily discover who are the best workmen by a study of the number and size of the logs delivered in previous years; the contractor whose logs have been Yathits with an average contents of 20 to 30 cubic feet demands no consideration and, if employed at all, should be given a forest where there is known to be little or no large size girdled or dead trees, whereas the contractor who has delivered over 100 logs for each elephant with an average cubic contents per log of 60 cubic feet is a man to be encouraged and treated with consideration.

5. We know from long experience that as a rule an elephant cannot do more than drag the logs which are furnished by 100 girdled trees, and in giving out contracts this should never be forgotten, and when there is no large quantity of neaped logs to be taken into consideration an area may be allotted to a contractor containing approximately girdled trees in the proportion of 100 trees to each elephant the contractor possesses, and this area must be clearly defined in the contract. If this is not done and the contractor is allowed to work in a forest containing a large number of girdled trees, he naturally takes all the trees which are standing close to the banks of the streams and perhaps obtains 200 or 300 logs per elephant, but in the following year neither he nor any other contractor is willing to work the same forest except at enhanced rates. Another mistake the Forest Officer is liable to make is to allot a forest to a contractor and enter in the contract that the contractor is allowed to fell 100 trees only without defining the area; this limits the contractor's outturn, but does not prevent him from taking only the trees which are easy to extract and leaving the difficult work to another contractor or demanding enhanced rates for it. Even in the case of a forest, containing dead and fallen trees only, a very large area should not be allotted to a contractor; there is a case on record in which a contractor working with only one elephant obtained 300 logs in one season, but, needless to say, he wanted extra rates for the next season's work.

6. If the contractor has a large balance of logs left either lying in the forest or neaped in the streams, an area containing a smaller number of girdled trees should be allotted to him, or, if he is working dead and fallen timber, he should only be allowed to fell as many trees as he can work out in addition to his arrears of the previous season. No fresh trees would be allotted to a man who had 100 logs per elephant not launched or 200 logs per elephant neaped, and in the case of a lesser number the number of

new trees to be felled would be reduced in proportion. Areas containing large trees should not be allotted to a contractor with small elephants who is unable to put two elephants on to one log to drag it, or the result will be either that the trees are cut into small logs to the prejudice of Government interests, or that all the large trees are left standing and, as they will be scattered over the area, the contractor who works them out will want extra rates.

7. Having obtained his contract the contractor should set to work at once so as to utilize to its full extent the working season, which generally ends with February, as in March owing to scarcity of water in the forest, and the heat rendering it inadvisable to work elephants hard, they are generally turned out to graze.

8 The first step towards extraction is to fell the trees and cut them into logs. The contractor sometimes employs coolies to do this, but very often the elephant drivers do this in addition to their other work. The felling and logging should cost about Re. 1 per ton. The forester in charge of the beat should keep himself informed as to the number of the trees felled and the number of logs obtained from them, and should send in reports from time to time, giving this information separately for girdled trees and for dead and fallen trees. The Divisional Officer should record this information in a book, and at the close of the year the total number of trees felled in each forest will be entered in Form 2A, but the number of logs obtained will appear in Form 4 and the monthly total in Form 6 for Forest depôts.

[NOTE.—In the Toungoo division, the rates for felling teak timber usually are—

For 100 logs 5¼ feet (8½ cubits) and above in girth ... Rs. 80
For 100 logs 4½ to 5¼ feet ... ... „ 50
For 100 logs under 4½ feet (6 cubits) ... ... „ 25

the average coming to about 12 annas per log or 10 annas per ton.

For felling and logging dead trees or for logging fallen trees in forests where no girdled trees are available the rate is Re. 1 per log or 13 annas per ton, the enhanced rate being paid to compensate the wood-cutter for the time he spends in searching for these dead and fallen trees.—C. J.]

9. The logs are dragged to the nearest stream which is large enough to float them away when in flood, but when the distance to a large stream is great the logs are often dragged to a smaller stream, and then it is necessary to employ elephants in the rains to push the logs along; this operation is known by the name of "aunging." There are in Lower Burma very few teak forests which are not intersected by numerous streams, and the average distance that logs have to be dragged does not exceed 2 miles, and the cost of dragging should not be much more than Rs. 2-8-0 per ton. If the logs have not already been marked with the forest hammer, this should now be done by the forester, who should never be allowed to mark logs after they leave the forest, and the use of

marking-hammers on a floating stream or rafting river either by the forester or the contractor should never be permitted.

10. As soon as floods occur the logs already launched float down the stream and others follow as they are launched, but the contractor has to employ one or more elephants in "aunging" logs down the small feeders and in setting logs adrift which get caught in the bends of the streams and by fallen trees, &c., and there are often places where it is necessary to have elephants stationed as long as the floating continues; such places include "thegawas," where owing to insufficient fall the stream is not confined to a narrow deep channel, but spreads over the land on either side and forms a shallow lagoon without sufficient current to move the log along even if the water is deep enough to keep the log afloat. "Aunging," &c., in most streams costs 8 annas per ton.

[NOTE.—It is difficult to express the cost of "aunging" in exact figures. If the elephants can do dragging work in the same localities where the "aunging" is done, the latter may be said to cause no additional expense.

If the elephants are kept to watch "thegaws" or other obstructions or form part of linked stations on the banks of a long floating stream, "aunging" is expensive and especially if the expected floods are delayed. In streams, the sources of which do not reach the main Yoma range, floods are very uncertain, and a case has occurred in which a batch of 1,200 logs had to be "aunged" for four rainy seasons before the timber reached the rafting river.

Again in narrow and tortuous streams two elephants can move 100 logs from ½ to 2 miles in one flood; in wider and straighter streams one trained and powerful tusker can work 600 logs or more over a distance of 4 miles or longer. Floods in feeder streams are of shorter duration than in main streams and almost invariably occur at nightfal lasting until mid-night or thereabouts. "Aunging" at night is of course more difficult and less effective than similar work in the daytime.—C. J.]

11. At the mouth of the floating stream the logs are either caught by men employed by the contractors or by the neighbouring villagers or by a "boom" consisting either of a large rope of twisted canes or of logs tied or chained together, and which is stretched across the stream.

12. When sufficient logs have been collected they are tied together in rafts and taken to the sale depôt, most of the logs in Lower Burma being sent to Rangoon. The rafts on the Sittang, which have to be passed through the canal, usually consist of 45 logs only, but elsewhere a raft often consists of 100 to 120 logs. Rafting to Rangoon costs Rs. 3 per ton from places on the Irrawaddy, Rs. 2 per ton from places on the Hlaing and Pegu rivers, and Rs. 3-12-0 per ton from places on the Sittang.

13. As a rule the felling, dragging, floating, and rafting are all done by one contractor, who undertakes to fell the trees and

deliver the timber to Rangoon ; and for this work a form of contract has been drawn up, which may be found in the guard-book. It will be noted that there are two schedules of rates—the lower rates are in force in the Tharrawaddy and Rangoon divisions, where the rafting to Rangoon is least expensive, and the higher rates are in force in the other divisions, where the distance logs have to be rafted to Rangoon is greater. Contracts in any other form, such as giving the contractor so much per ton, whether the logs be heavy or small, or giving him a percentage of the proceeds arising from the sale of the timber, have been abandoned, and they should in future only be entered into in exceptional cases and with the previous sanction of the Conservator. The schedule of rates in the Tharrawaddy contract has been well considered with a view of giving the contractor a fair rate and at the same time of giving him a larger rate per ton for heavy logs than for small ones. Under this schedule the contractor receives (with a few exceptions in the case of short logs) for logs with an average contents of—

	Per ton Rs.
Under 20 cubic feet	6
From 20 to 30 cubic feet	7
From 30 to 40 cubic feet	8
From 40 to 50 cubic feet	9
From 50 to 60 cubic feet	10
From 60 to 80 cubic feet	11
From 80 to 100 cubic feet	13
From 100 to 120 cubic feet	15
From 120 to 150 cubic feet	16
Over 150 cubic feet	17

There is one fault about this schedule of rates, which arises from the limits of the girth classes being so large as 18 inches (the Burmese taung) ; for example a log 30 feet long and from 6 feet to 7 feet 5 inches girth costs Government Rs. 22 for extraction. For an average log of this class 6 feet 9 inches in girth the contractor receives Rs. 13 per ton ; if the log is only 6 feet in girth he get Rs. 16 per ton, and if 7 feet 5 inches in girth only Rs. 11 per ton. With a large number of logs of one class the contractor probably receives the average rate which it was intended he should obtain, but when only a few logs of a particular class are delivered the contractor is liable to receive a rate either much greater or much less than it was intended he should receive. This anomaly might be removed by a contraction of the limits of the girth classes, but a narrower limit than the foot would give much trouble and extra work, and the Burman is used to his cubit and has a great distrust of any tampering with rates that he has been accustomed to. Instances have occurred in which contractors have refused to work under a revised schedule of rates, even though the new rates were more favourable to them than the old ones.

This schedule of rates has been found sufficient for the average forest in the Tharrawaddy division and in most forests where trees are fairly plentiful, but in some forests where the logs have to be dragged long distances the rates are inadequate, and in such cases a clause is added to the contract that the contractor shall receive an addition of 10, 20, or 30 per cent., to the amount which he would receive under the schedule; this has been found much more simple and satisfactory than giving him an extra rate of Re. 1 or Rs. 2 per log. These extra rates should not be granted without a full enquiry as to the difficulties in the way of extraction and never without the sanction of the Conservator.

[Note.—In considering to what degree the dragging in a certain forest is difficult the nature of the ground has to be taken into account as well as the distances. In a fairly level forest, average sized elephants can drag logs of 60 to 65 cubic feet each, or two or more elephants can be made to drag one big log; buffalo-dragging can be *resorted to with great advantage, and in the dry* season elephant and buffalo carts can be used.

In hilly forests where the timber has to be dragged several times up more or less steep inclines, and to be rolled down in places which are too steep from dragging, the work is very trying even for the strongest elephants. In fact in such places small elephants can do little work, as it is impracticable to make several elephants drag one log up a steep and narrow dragging path as they seldom pull together, and the strongest of them does all the work. Only tuskers can work logs down steep hillsides, and it is very tedious work; the logs when rolled or pushed down are caught on the way by bamboos or trees, and the tusker has to follow them and start them again, finding a footing with difficulty. When dragging heavy logs in hilly forests elephants are very liable to hurt their feet; the cuts and sores fester badly and often incapacitate the animal from work for months.

Another feature of working in hill forests is the want of grass-fodder; bamboo leaves will not keep an elephant in condition over heavy dragging-work, besides the animal wastes a good *deal of the time allowed him to feed and rest in walking long* distances in an unsuccessful search for grass.

In some forests the compensation which the contractor has to pay for damage done by his cattle to paddy-fields, taungyas, or fruit gardens forms an item that needs consideration.

When timber has to be dragged or "aunged" through miles of the paddy plains between the hills and the river the compensation runs up into big amounts, and in addition causes friction between the contractor and cultivators, and sometimes even litigation —the most expensive complication, as it takes the contractor away from his work for an indefinite time.—C. J.]

14. The contractor generally requires money before he has completed his work by the delivery of his logs in Rangoon. Although we call payments made in such cases "advances," they

are not really "advances," but "part payments;" and Divisional Officers are responsible that these "advances" should be fully covered by work done; any payment not covered by work done, and which really partakes of the nature of an advance or loan to the contractor, should only be made under proper authority, and Government should be secured against loss by the mortgage of the contractor's elephants or other property.

15. Another matter connected with the extraction of timber is *the clearing of floating streams of fallen trees, stranded* logs, and other obstructions. The best time to carry out this work is March and April, when there is little water in the streams, and fire can be used to remove some of the obstructions. Native contractors, especially when more than one man is at work on a stream, will neglect this work unless they are looked after.

16. With regard to the cost of dragging it will be of interest to investigate the expenditure involved in the purchase and maintenance of elephants. If the average dragging elephant in Burma costs Rs. 1,800 and the life of an elephant at timber work averages 15 years, then the capital involved (allowing interest at 5 per cent.) to purchase an elephant and to replace it every 15 years is $\frac{1,800 \times 1{\cdot}05^{15}}{1{\cdot}05^{15}-1}$. = Rs. 3,468 and the yearly cost is Rs. 173. Attendants cost Rs. 26 per month or Rs. 312 per annum; the cost of medicines, repairs to gear, and other incidental expenses may be put down at Rs. 25 per annum; *the annual work of an elephant costs* therefore Rs. 510. An elephant can drag and "aung" 140 tons in a year in a fairly difficult forest, and the cost of dragging and "aunging" in such a forest is Rs. 3-10-0 per ton. For dragging alone the cost is probably less than Re. 1 per ton per mile. The outturns given above are the actuals of the Swa forests on an average of four years. A Burman or Karen would not pay his men so highly, but on the other hand his outturn would be smaller, and the cost per ton would probably be about the same. The cost of "aunging" cannot be determined very well separately. In the Pyinmana forests, in former times, the rate paid for logs delivered on the banks of a floating stream was about Rs. 4 per ton, while for logs delivered in the rafting river Rs. 6 to Rs. 8 per ton were paid, and the difference Rs. 2 to Rs. 4 was not considered too great by contractors, as the man who worked for bank rates was *paid for every log he dragged out, whereas the contractors who* were paid for logs delivered in the river lost a great percentage of the timber they had launched; the Rs. 2 to Rs. 4 cannot therefore be regarded as the cost of "aunging."

17. The following information with regard to the construction of rafts has been collected from various sources,—"Timber floated down the Sittang and arriving at Toungoo from above is formed into rafts consisting of 42 to 60 logs; as the average log is about 63 cubic feet a raft may be said to contain 57 tons of timber. A raft has five sections, into which the logs are sorted

according to their length, some sections consisting of Luzars only, others of Dugyis and Yathits, with perhaps two short pieces placed in one line between long logs. To this sorting of the logs the long time raftsmen spend over their work at Toungoo is partly due. The size of a raft is limited by its width; a section of Luzars contains therefore fewer logs than one of Dugyis or Yathits. If a section consists of nine logs, seven are fixed together by their end, being strapped on to two cross-poles (bo-dôns) and canes passed through the drag-holes (napa-thi-Kyeins); the strapping is done with split canes of the "Kyein ban" and "Kyein bok" description. The other two logs are attached loosely, one to each side of the section, and are called "Ban thits." The sections are connected by two strong lashings of canes called "Ka sets." Strappings and lashings are effected in such a way that they can readily be untied in case the raft grounds and has to be shoved off; if a raft grounds in a falling river, the raftsmen often have to shove off the logs singly. When floating the raft is guided by four oars—two at the prow and two at the stern; a raft frequently slews round in the river and then the position is reversed. Rafts are not voluntarily moved at night, but made fast to the bank every evening; for this purpose they have two mooring canes, to which is attached a pointed stake (Kwèdaing). On the quality, length, and strength of the mooring canes and on the skilfulness and judgment of the man who handles them the safety of the raft mostly depends. Good long mooring canes (120 to 150 cubits long) are eagerly bought by raftsmen at Rs. 3 to Rs. 5 each. The "Kwè-thama" is the best paid man of the crew, which consists of three men in all. The rowlocks, to which the 18 feet long oars are attached, are called "Kat-Kundaings." The centre section has a hut for the crew to sleep and cook in; it is very carefully built of bamboos and thatch, and unfortunately is often converted into a gambling saloon, most of the Sittang raftsmen being inveterate gamblers. Rafts go down stream in batches of 12 to 20, seldom 25, which are in charge of a headman. The voyage from Toungoo to Rangoon can be performed in three weeks, but usually takes much longer, the average duration being little short of six weeks. The delays are due to some of the rafts breaking up on the way, such mishaps being sometimes caused by the snapping of both mooring canes when the rafts may come into collision with fallen trees, snags, or sandbanks. Frequently the raftsmen bolt, abandoning their raft or even selling it to a drift timber collector. In either case the headman has to collect the logs again and to engage a fresh crew. Owing to the difficulty of his task especially if the crews and head raftsman are not carefully selected, the headman is very highly paid. Each raft has a canoe, in which the "Kwè-thama" paddles to the bank when it is necessary to moor the raft. Above Toungoo rafts are made up with less care; those starting from below Myohla have usually no "napathi" canes and

the logs are strapped to the cross-poles with creepers which the raftsmen cut themselves in the forests. Rafts from Myohla and above have "napathis" and "Katkundaings." These upper rafts have usually four sections and contain from 25 to 45 logs, and are managed by a crew of two men only. During the height of the rains rafts starting from Swa arrive the same day at Toungoo. Myohla and Yeni rafts are one night on the way, rafts from Yonbin and Sinthe two nights.

18. "The cost of rafting on the Sittang is as follows: —

	Rs.	A.	P.	
Raft hire from Swa	1	1	0	or an average of Rs. 1-4-0 per log.
Including from Myohla or Yeni	1	4	0	
Bank salvage from Yonbin	1	8	0	

For Upper Burma timber these rates have lately been raised by four annas or more per log. The cost of a raft of 45 logs or 57 tons is—

	Rs.	A.	P.
Expense above Toungoo as above	56	4	0
Contract rate from Toungoo to Pazundaung ...	110	0	0
Bonus for correct delivery { To headman	5	0	0
Bonus for correct delivery { To chief raftsman ...	10	0	0
The canoe costs Rs 10, is brought back from Rangoon twice at an expense of Rs. 5 for each trip and eventually sold for Rs. 2	6	0	0
Four oars costing 8 annas each and used twice ...	1	0	0
Two stakes costing 4 annas each	0	8	0
Seven Yamata canes at Rs. 1-4-0 each .. .	8	12	0
Canal dues at 4 annas ... ... ~	11	4	0
Raft hire from Pazundaung to Alôn—45 logs at Rs. 35 per 100	15	12	0
Contract stamp and sundries	0	8	0
Total ..	225	0	0

or Rs. 5 per log = Rs. 3 = 15-2 per ton. Rs. 49 per raft are paid in advance on the raft leaving Toungoo; Kabaung contractors contract with raftsmen usually at Rs. 4-8-0 per log delivered at Alôn depôt, bank salvage and all expenses included; Pyu and Kun contractors at Rs. 4 to Rs. 4-8-0 per log, the contractor making an advance of about Rs. 25 per raft on starting and a further advance of Rs. 5 at Shwegyin. The above rates hold good if the rafts are correctly delivered, but, if the men lose revenue-paid logs on the way and they are not eventually recovered, the owner loses the value of his timber as the raftsmen are only liable to a fine of Rs. 10 per log lost.

19. "Rafts of In timber consists of 25 logs ratted in five sections; 1,200 bamboos are used for the floats of one raft, but including huts and breakage 6,000 bamboos are generally provided for 100 In logs. An In raft has a crew of two men; the raft hire from Myohla to Kyaikpadaing is Rs. 110 if the crew provide themselves with food, or Rs. 95 if food is provided by the owner of the timber. The bamboo floats are about 2 feet square, tied together as close as possible with cane withies. The floats carry the two cross-poles, which are stronger than those for teak rafts,

and the logs are strapped on to the cross-poles by means of 'napathi' canes passed through the drag-holes. In rafts cannot be moved before November when the river has fallen and the current is less strong than in the height of the monsoon ; the journey takes a long time. In logs worked on streams like Hmon, Kyaukgyi, Shwegyin, &c., are floated down these streams with boats or boat hulls, two or four logs being lashed alongside the boat according to the size of the boat. The floating hire is about Re. 1 per log.

20. "Rafts made up at Prome vary in the number of logs which they contain from 75 to 100 logs per raft, but the usual number is 80. The smaller rafts of 75 logs consist generally of five sets, each set containing 15 logs, but this is only done with small logs. The usual custom is to have six sets of logs which vary from 12 large logs to 15 small logs in a set. In making up the raft the longest logs are placed on the outside and in the middle with the shorter ones between them. The logs in the front of each set have a split bamboo passed through the drag-holes and on the top poles are laid, to which the bamboos are tied with small canes ; at the back end of each set poles are likewise laid on the top and the logs are fastened to them with small canes ; at the back end more poles are necessary as the logs of course are not all of one length and the split bamboo is not used. To fasten the sets together five or six logs in the first set are attached with split bamboos, which are passed through the drag-holes to five or six logs in the second set, the ends of the bamboos being tied with small canes to the poles, and so on with each set. Near the front of the first set and near the back of the last set a log is placed at right-angles to the logs forming the raft and fastened firmly to them by passing small canes through the drag-holes to each end and through extra holes made in the under logs. Long ropes measuring about 200 feet in length and 3 inches in girth are attached to these cross-logs, and when it is necessary to tie up for the night the ropes are conveyed to the bank and the other ends are fastened to stout stakes which are driven firmly into the ground. To steer the raft five oars are fastened in front and five behind. The crew consists of a head raftsman and three under-raftsmen ; two men work in front and two behind, the headman being in front ; the extra oars are to replace any that may get broken. The huts are built of a framework of bamboo and roofed and walled with thatch ; each raft is provided with one canoe, 20 spare poles, 50 spare small canes, and three small ropes. The best season for floating is the end of November and the beginning of December, and it takes about 20 days for a raft to get from Prome to Rangoon if no halts are made. The men are usually paid as follows for the trip : Each head raftsman Rs. 30 and each under-raftsman Rs. 20. Contractors' timber from the Nawin stream is, if possible, all sent down to Rangoon at one time with one head raftsman in charge of the whole, who gets about Rs. 40 for each raft."

21. The rafting of pyinkado on the Ngawun river is conducted as follows :—"The method of forming rafts of pyinkado logs north and south of Bassein varies slightly. North of Bassein the logs are dragged to the foot of the hills and lashed on to boats (as in Shwegyin); on arrival at the Ngawun river each log has bamboos fastened to the sides with canes or creepers. Usually ten of these logs with the bamboos are placed side by side and a pole put across the ends of the log and fastened with canes to the drag-holes; sometimes a pole is also fastened across the centre of the raft. Five of these small rafts are made and fastened together with ropes and form one large raft. South of Bassein the logs are floated down small streams with bamboos fastened only on one side of the log; on arrival at the rafting stream 10 logs are put together and a pole placed across and fastened to the bamboos at the ends and the centre. The quantity of bamboos required for making a raft of 50 logs varies with the size of the bamboos. Formerly Kyathaung of good size was used and 500 bamboos were sufficient for a raft, but for the past two years Kyathaung has not been procurable, and Tinwa and Kayin are mostly used; it requires 1,000 bamboos of the former or 2,000 of the latter to make up a raft."

22. The following is an account of the rafting of bamboos on the Ngawun river :—"The bamboos have small pieces cut out similar to drag-holes, 20 bamboos are placed side by side, and a piece of bamboo passed through the holes; then five such lots of 20 bamboos are placed on the top of one another and fastened round with strips of bamboo ('hni') and form what the Burmans call a 'Kadon,' each 'Kadon' consisting therefore of 100 bamboos. Five 'Kadons' are made and placed side by side and fastened to two poles, one of the poles being near the drag-holes and the other across the centre of the 'Kadons.' Five more 'Kadons' are then made and fastened to the centre pole on the top of the other 'Kadons,' but leaving about 6 feet of the lower 'Kadons' uncovered; five more 'Kadons' are then made and similarly treated until the raft is completed. A raft generally consists of 20 rows of 'Kadons,' containing therefore 100 'Kadons' or 10,000 bamboos."

23. On the Pegu river the process differs somewhat. "The bamboos are first cut into lengths varying from 20 to 30 feet, according to the kind of bamboo; a small hole is then cut through the small end of each bamboo, and they are then strung together in fives by passing a split bamboo ('thidan') through these holes. Four of these lots of five bamboos are placed one on the top of the other (the thin ends pointing the same way) and are bound together, forming a bundle of 20 bamboos. Fifteen to 17 of these bundles are placed side by side (the small ends all pointing to the front of the raft), and secured together by two cross-poles, to which each bundle is fastened. The manner in which each bundle is lashed to the pole ('Po') is ingenious, a short split bamboo ('Kyet') being

inserted under the pole, the lashing passing under the 'Kyet' and over the pole and forming a very secure fastening; the outside bundle on each side of each section of the raft contains a few bamboos 2 or 3 feet longer than the rest; these are called 'Sweyanwa' and keep the succeeding sections in the same direction as those that precede them. A top layer of 12 or 15 bundles is then laid on the raft, each bundle made up in the same way as those forming the lower layer, but not secured to each other by a cross-pole. Each section of the raft, therefore, contains from 27 to 32 bundles or 540 to 640 bamboos. To facilitate steering in deep water there is an arrangement called a 'Kakron' in the first and last section of each raft; this is formed by a thick upright bamboo post planted on one of the cross-poles; through a hole at the top of this post is run a bamboo yard, which is tied down firmly, and this keeps the post upright; to the top of the post is fastened a rowlock for a long oar."

24. The following notes will furnish information regarding the catching of logs when they emerge into a rafting river from a floating stream down which the logs have been allowed to float singly. "Salving in the Sittang above Toungoo is done very vigorously and effectively. In places like the villages below the mouth of the Swa, where there are a large number of logs to collect and where a cloudy sky in the proper direction or heavy rain warns and prepares the villagers, the logs may float out during the night, it is very paying work; and a number of villagers engage in no other occupation during the rains. Three villagers of Swabauk lately salved 125 logs during one night and the next morning. Some years ago it was difficult to get men to collect the logs salved by the villagers and to raft them to Toungoo promptly, particularly to make the collectors pay full salvage rates. This led to encouraging the bank-salvers to raft the logs themselves to Toungoo. In the beginning the men had to learn how to raft quickly and how to manage the raft on the way and on arrival, and many mishaps took place. However, they saw they were paid well and promptly, and now have taken so well to the work that for years no obnoxious middleman has been employed to collect logs floating out of the Swa. The salvers work now without money advances, and the only assistance they get is a supply of good mooring canes at cost price.

25 "The Swa is too wide at its mouth to have a boom (Kyodan or Thitaga); the men go into the stream in canoes, or station themselves on the bank at places where the current brings the logs close in shore, swim for them, and haul them in with ropes. Although very few logs from the Swa pass Toungoo without being salved, the salvage of 2,000 logs coming out in one flood gives work to all the villagers on the river-bank down to Toungoo, and, if a much larger number of logs did float out at the same time, the whole of them would not be salved above Toungoo; this is, however, a very rare occurrence."

26. "Below Tonngoo salving is done also by villagers living on the river-bank, but as the supply of logs is smaller and less regular and comes without warning, fewer people take to the work as a regular occupation. The collecting of the logs is therefore done in the old style by drift collectors, who redeem the logs from bank salvers and raft them to the depôts at Inbalwè and Myitkyo.

27. "Booms (Thittagas or Kyodans) have been used at the mouth of creeks which are not too wide and have not too strong a current. They consist of canes or iron chains, to which logs are fastened to keep the logs afloat and stop any logs which may drift down the stream. The purpose was to prevent the logs from going adrift in the rafting river, which before the annexation of Upper Burma was of importance, and to save bank-salvage. The raftsmen would, after the flood which had brought the logs down had subsided, work the timber out of the 'Thittagas' and form it into rafts. The disadvantages of 'Thittagas' were that some time was lost over working the logs out as they would jam and form a 'taik' inside the boom, which soon silted up and would render the employment of powerful elephants necessary to get out the logs. Some logs would always become buried in the sand to such an extent that they could not be pulled out at once, and either were totally lost or had to be dug out in the following dry season. Some streams like the Yeni have so little fall that there is never a strong current at their mouths so long as the river is high. In the Yeni a plain 'Kyodan' of canes is strong enough to stop the logs, and they can usually be worked out by the raftsmen with the assistance of elephants."

P. J. CARTER,
Conservator of Forests, Pegu Circle.

Conditions of Forestry as a Business.

Writing in the *Engineering Magazine* of New York, Mr. J. Beale, M. S., Ph D., says:—

Forestry is a business, like agriculture an industry which is concerned in the production of a soil crop. It is the art of managing a wood crop so that it will make the best harvest of timber in the shortest time at the greatest profit. Forestry differs from agriculture, however, in that it takes many years for the crop to mature, and the crop is then a complicated one. Forestry in the United States as a defined business is now in its earliest stages—chaotic and undeveloped. In its most perfect conditions, forestry is not a single science or art, but combines relations to several sciences and arts. On its scientific side it touches botany, chemistry, geology, meteorology, physics, geography and entomology; on the art side it touches horticulture, arboriculture, lumbering, and protection from fires.

In parts of Europe the growth of timber is already well systematised, but knowledge of the subject in all its details has been of slow growth. More than a hundred years ago a few alarmists in Europe prophesied an approaching dearth of timber. This agitation helped to induce economy in the use of timber, and to delay the evils predicted. Without giving the strictest attention to systematic arrangement, we may note some of the chief attainments by the leading countries of Europe in the management of forests, and the methods adopted to accomplish such results.

It would seem that Government ownership and control of much of the forests in the old countries gave a great advantage over our newer country, where "private enterprise" accomplishes almost everything. There, even the woodlands of corporations and of individuals are subject to the laws of the country, which specify *how much* may be cut in each year. These laws are enforced by officials well educated for the business. Forests are systematically inspected, and reports made concerning their condition and needs. The inspector acts as "a paternal adviser" to all owners of forests. In the words of a recent American consul to Austria-Hungary:—"The owner of forest land in Austria must exercise extraordinary care not to be guilty of trespass upon his own land." How different the feeling of owners of land in the United States. In the country above referred to the array of forest officials of various grades maintained numbers nearly 32,000 persons. *In all of these particulars the fact must not be lost sight* of that wages are much lower and interest on investments much less remunerative than in the United States.

The large number of officials who must pass rigid examination makes it possible and even necessary to maintain numerous schools to keep up a supply of skilled men. The encouragement of profitable employment induces pupils to patronise the schools, which give laboratory or practical work, often in the forests, as

well as lectures in the classroom. To some extent these subjects are taught in other schools than those for the special object of educating foresters. These officials usually serve for life, and are pensioned in old age or in case of disability.

By dint of great energy of a few persons in this country attention has been called to the greed and dishonesty of men who steal timber from the public lands, and to the evil effects of removing vegetation from mountain slopes. Many instances of the same kind have been enumerated in Europe, where the evil effects remain as a warning to newer countries. The cost of reclaiming some of these waste places has been great. In this reclamation seeds from the scattering trees cannot be relied on to furnish seedlings for the new growth, but nursery-grown stock must be well set, and afterwards properly cared for. Experience has led to the formation of many rules in relation to forest management. For example, on sandy soil and on steep mountain slopes, timber can only be cut in narrow strips, or thinned out. Grazing among timber is rarely permitted. Stringent rules in regard to igniting fires in or near forests are enforced

Between 1860 and 1887 France reforested over 250,000 acres of mountain lands at a cost of 30,000,000 dols., the State paying one-half. In 1887 the total annual appropriation for the forestry department of France was 5,000,000 dols. Here the people of the United States may well take warning. How much more economical it would be to spend a little money now in preventing devastation than to suffer the consequences for a time, and then possibly spend enormous sums in restoring the forest to the mountain slopes.

In Germany about 25 per cent. of the entire area is devoted to forests. Of this amount about 32 per cent. is Government land, 15 per cent. belongs to the communities, 1·3 per cent belongs to charitable and other institutions, 2 per cent. belongs to corporations, and 48 per cent belongs to private parties. Without the supervision of State officials "a reckless devastation of forests would be the consequence," just the condition we are experiencing in most regions of our own free country. In the Eifel district the mountain slopes were reforested and otherwise improved at the expense of the Government, though much of the land belonged to communities.

A chief director of forests in Germany, in writing to a United States consul, says:—"You are certainly quite right when you speak of the importance of forest culture for the United States, but allow me to express my belief that no earnest work in that direction will be accomplished there. The culture of the forests proceeds too slowly to suit your countrymen, and the profits are not forthcoming soon enough. In my opinion good results from forest culture can only be had in the United States when the Government shall have taken the matter into its own hands." Dr. Otto von Hagen says:—"The forest is a trust handed down to us

'from past ages, whose value consists not alone in the income derived from wood, but also in the importance which it exerts through its influence on climate and rainfall or land culture. Its importance is not merely a question of the present day or of the present ownership, but is also a matter which concerns the future welfare of the people." For these and other reasons it has been determined that it is a duty to interfere by legislation with the waste of timber.

Think of the time required to grow trees of certain species fit to cut for important purposes. In Germany the age for cutting oaks is 150 to 180 years; beech, 100 to 120 years; Scotch fir or birch, 30 to 100 years; though for some purposes, of course, trees are cut when much younger. One of our consuls to France in 1887 observed that "forests are much more easily destroyed than replaced, for in three years, from 1788 to 1791, almost as large an area in France was deforested as has been reforested in the last ninety years, although much attention has been paid to the subject during this time."

The older and more thickly-settled countries of Europe have all passed through the stage in which many of our States have but recently passed or are now passing. Their land in most instances was well covered with forests. They cut and fired and wasted as we are doing, and have long been aware of many of the evil effects of this practice. To what extent shall we learn and profit by their mistakes?

Under the circumstances, what can the people of the United States accomplish? In what ways can we best secure a reform in forest management? Legislation, whether state or federal, will accomplish little, until there are enough stalwart persons thoroughly interested to continue under adverse conditions to work for the success of a better management of lands in forests or lands which ought to be covered with forests. Something may be done by forest commissions, but too much is likely to be expected of them, and to save expense somebody will advocate their abolition—and somebody sooner or later will succeed. The value of forestry commissions consists chiefly in giving advice and in educating the people.

Tree-planting on a large expensive scale is not likely soon to be so skilfully conducted that satisfactory profits will be apparent. But, notwithstanding, trees of every kind should be planted in many places, and the sooner the better for us all. Probably not one in a thousand now knows enough about the subject to proceed intelligently to take the best care of his forest, or to reclothe land with timber in the most economical manner. Those who try the experiment should be able to wait.

Over a hundred years ago some persons in Europe were foolish (?) enough to plant a few white pines from North America. In the language of our time they would be known as "cranks," and yet who shall dare place a sufficiently high estimate on the

value of that simple experiment, for it has demonstrated that our white pine is one of the best of trees to grow for timber in that country? We need men in every country of every state who will have enthusiasm and foresight enough to plant a few trees in places where there may be a prospect for growth a long time without molestation. Before these experiments are completed there will be many anxiously waiting to profit by the results.

We live in a comparatively new country, where our fathers and grandfathers cut down and burned the finest of trees to make room for crops and pasture. We have been taught to destroy trees and not to save them much less to replant. The arguments for preserving the virgin forests of a new country are by no means all on one side, and no one should expect the trees to be preserved. In most cases, the profits of holding are too small to pay for the investment.

Michigan once had about 150,000,000,000 feet (board measure) of standing pine, which was believed to be well-nigh inexhaustible. Those now living find remaining only comparatively small tracts in the back counties. Even with what might be considered good management in a thinly inhabited country, where lumber was cheap, it was soon found next to impossible to preserve this timber, however much the owners might desire to do so. In many seasons the fires destroyed as much pine as the woodman's axe. Dead pines must be cut to save them, and the *debris* was almost sure to burn and the fire to spread to the standing trees. To some extent the same condition of things prevails with regard to the "hardwood" trees, though in most cases these are not so likely to be destroyed by fire. In a business way there are men now spending much time and money in defending their remaining pine lands from fire. But more system is needed, and the care should be more general than it ever has been.

The study of European methods and results in forestry by competent men is not enough, says one writer. It is not even the most important thing for us. Nothing can be very useful to us which is not based upon careful study of conditions peculiar to this country. We must have in time a system of American forestry if we are to avoid serious disaster to our national interests and civilisation. The forestry of this country must be the product of growth which has as yet scarcely begun. It will be developed by continued and widespread observation, and by constant comparison of the results of practice. It is necessary to remind ourselves that no useful system of forest management can be originated or created by legislative enactment. There must be special knowledge and national good sense regarding the needs of this country behind forestry laws, or they will be useless and mischievous.

It is important to understand the value of great areas of growing trees on the surrounding cultivated land, and to know in what respect they check fierce winds, prevent rapid evaporation of moisture, or encourage late frosts in spring. But the possession

of this knowledge is not likely to induce men to save trees or to plant trees for the benefit of persons owning farms in the surrounding townships or in other counties. Here is one of the best of reasons why the state and nation should take an active part in the management of forests

It is difficult to induce most persons to understand fully the results of a timber famine. They have heard more or less of this talk for years, but they believe the day is yet far distant when our people will suffer much inconvenience from lack of timber. They argue that as timber becomes scarce and more expensive, less of it will be used. We shall burn coal for fuel, and use more iron and steel. Transportation will be cheaper, and timber can be transported for long distances. The use of the land to produce various grains, grasses, fruits, and vegetables will help to pay higher prices for timber.

In the moister portions of our country, when the original forests were cleared away, seedlings and sprouts in immense quantities sprang up to contend for every foot of available space. In cutting away the valuable timber there are usually large numbers of "young things" up to 6 in. or more in diameter which, if protected from fire and other destroyers, have already made a fair start toward renewing the forests. Too little care is usually observed in protecting this young growth, which is admitted to be of no value at the present time. Because there are no dollars in them now the proprietor is likely to let them go to waste. In very few instances in moist climates would it be necessary to plant trees started in the nursery.

The writer has often been asked by bright young men of no resources, except their active brains and hands, "What is there 'in this country to encourage a young man, who must earn his 'living as he goes along, to make a specialty of forestry? I like 'the subject, and if I saw a good living in the business I should run 'the risk and go ahead." I am free to say that so far work in this field seems to be done gratuitously.

A few persons in our agricultural colleges have done a little in this direction, mainly to call the attention of students to the magnitude and importance of a study of forestry. Before any one of us thought much about trees the course of study in these colleges were replete to suffocation with subjects of seeming importance. Elective courses are expensive. The writer has twice given a course of lectures daily for twelve weeks to members of the senior class of the University of Michigan, or to those who elected forestry. A course on parasitic fungi runs parallel with that on forestry, and only one of the two can be elected. No doubt there have been similar reasons in the other schools to prevent giving more attention to forestry. But if we are interested and make the effort we can all find some opportunities for this work.

Lectures at farmers' institutes in many states afford some opportunity. But here the indifference of the hearers tempts us to

select other subjects. Vividly does the writer call to mind one occasion at an institute in a new county in which he spoke of the importance of preventing forest fires. The first one to lead in the discussion was a farmer living in the neighbourhood, who won the applause of the audience when he said of these fires, "They are the 'best friends we have in clearing up the country."

The more students know about trees, the more they are likely to be interested in this subject. The things to be learned are the different species, their names, their anatomy and physiology, their rate of growth and geographical distribution, their special uses in the arts and in nature, how to raise trees from the seeds, how to plant and where to plant, and why, and especially how to take proper care of them after setting. He who fully understands the structure and functions of roots will never be seen carting living trees with roots exposed to dry wind and sun for miles along the highway. Students may be set to investigating the effects of pasturing a wood-lot by noting examples of those pastured and those left to themselves. They may estimate the amount and value of an acre of good, medium, or thin forest, and note the time required to produce it. The effect may be noted of trees as a shelter along the highway or near dwellings, barns, and sheds. Other questions are, why are certain trees found growing in swamps and others on dry land? Why are there no pines or cedars in some neighbourhoods, and no beeches or maples in others?

Besides the means suggested for aiding the cause there are others. If the programmes were judiciously prepared and well carried out, the celebration of Arbour Day by school children would have a tendency to awaken an enthusiasm among the people; but usually the exercises consist mainly of quotations from literary authors scraps of poetry, history, and sentiments - rather than any substantial information pertaining to the needs of forestry. *The establishment of an arboretum, even a small one,* on some of the farms of enterprising people, and more especially at each agricultural college and experiment station, would help to educate and interest the people. We cannot soon expect to see an Arnold arboretum in every state, but the beneficent influence of that garden has already reached thousands of miles.

Associations for securing the protection of certain private natural scenery help to educate every one who sees the reserves. Botanic gardens containing shrubs and trees are likely to increase in numbers, each good one lending encouragement to others. So of herbaria, *and especially of museums of plant products, which* should contain no end of interesting specimens of timber, not only those which were well grown, but likewise all manner of monstrosities. The writer a few years ago collected and placed in position a unique collection of this kind, and considering the cost, it was more attractive than an ordinary museum of fossils, minerals, or stuffed animals. Who can tell the good results likely to occur to

forestry from the establishment and maintenance of the Jesup collection in Central Park, New York?

Several books have appeared that are worthy of notice, but none of them can be compared with "*The Silva of North America*," by Professor C. S. Sargent, the first four volumes of which have been published. In several States, reports have been issued by Forestry Commissions or Forestry Associations, or special bulletins on the subject have been published by experiment-stations. The United States Government has, through Mr. Fernow, the efficient head of the Forestry Division of the Department of Agriculture, for some years past been active in advocating measures of importance in relation to forestry. Bulletins and reports and gratuitous lectures and frequent conferences with Congressmen have all had their effect in awakening an interest in this subject. From the condition of things here outlined, it will be seen that the growth of an interest in forestry must be slow for some time yet, but I anticipate very great changes in the sentiment of our people and the formation of salutary laws by the close of this century.—*(Timber Trades Journal.)*

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A tour in the Landes and visit to the French Resin Works.

Introduction.—I arrived at Bordeaux on the 28th of November, and on the 29th I proceeded to visit M. Muel, the Conservator of *Forests, who directed me to M. Grandjean, Garde Général in charge* of the Forest of La Teste, but as that officer was absent on tour, I proceeded direct to Arcachon on the 30th in the hope of finding him there. I was fortunate enough to meet him on his return from tour on the 1st December, and he and the Brigadier accompanied me in an inspection of the forest blocks in the immediate vicinity, and were good enough to show me everything of interest.

On the 2nd December we made a long tour to the South in the direction of Simaphore, and visited on the way a considerable portion on the State forests as well as the private forest of M. Conseil, where we had ample opportunity of studying the resin-tapping operations as carried on in both classes of forests. The season was not, however, well suited for seeing the collecting work at its best, as the busy time lasts from *April to October only, and during the winter little work is done.* We also visited the great artificial dune constructed along the coast to check the movement of the drifting sand, and we also saw a place where the inroads of the sea had destroyed the artificial embankment. We also saw another place where a private proprietor had neglected the maintenance of the works, with the result that a considerable belt of forest got buried by the sand. In the same vicinity we saw the site of a most disastrous conflagration which burnt a large area of forest during May 1893, and which tended to impress me with the fact that the system of fire lines, as constructed in this part of France, is apparently not very effective.

On the 3rd December I visited the important resin factory of M. Lesca, near La Teste, where his agent showed me over the works and explained all important points with regard to the manufacture of colophony and turpentine, also regarding the sale of the same.

On the 4th I made further notes and observations, and started in the evening to join my steamer at Brindisi by the shortest route, *viz.*, Marseilles, Genoa, Rome and Naples, and arrived at the port of embarkation on the 9th.

Forest of La Teste.—The forest of La Teste is situated to the west of Arcachon in the Department of the Gironde and in the Conservatorship of Bordeaux. It consists of what may be called four patches, the principal one of which, situated on the Bay of Biscay, has a length of about eight miles, with an average breadth of about one and a quarter miles. The other three plots are situated on the Bay of Arcachon to the west of the town, and are much cut into by the compounds of villas, roads, &c. The area of the forest is about 6,000 acres, but the extent was at one time nearly four times its present area. The reduction took place mainly about 30 years ago, when after the Mexican war the State being in want of funds, large areas were sold to private individuals. The prices then obtained were, it is stated, very advantageous, owing to the high cost of resin and turpentine after the American war, when they fetched in the market more than double the rates that can be obtained now.

The soil of this forest of La Teste consists of almost pure sand thrown up by the sea, but underneath the sandy layer, traces of peat and of a ferruginous sandstone, called *alios*, are to be found, and this, probably, formed the surface of the ancient landes or beds of the old marshes. Judging from the stumps of large trees, which are occasionally found embedded in the peat, it is probable that up to about the year 1200, when the forests became gradually destroyed by the increasing population, the greater part of the dune area was thickly covered with pine forest down to the water's edge.

The annual rainfall of this district is stated to be about 30 inches, and is, as a rule, well distributed throughout the year, but droughts occur occasionally during the months of May and June when, as a matter of course, forest fires usually occur.

The neighbouring population was formerly strictly a pastoral one, but since the planting up of the dunes has commenced, the number of flocks has greatly decreased, and the people are now largely employed on the resin-tapping and timber operations in the forests.

The sand dunes extend for a distance of about 125 miles from the mouth of the Gironde as far as Bayonne, and some of them rise to an elevation of 230 feet. Those situated immediately along the coast are called the "dunes blanches," or white sand dunes.

The principal species of tree found in these forests is the cluster pine (*Pinus Pinaster* or *maritima*) with here and there a few oaks (*Quercus pedunculata, Toza* and *suber.*) The undergrowth consists of broom, gorse, brambles, ferns and heath. There is practically no grass in these forests; but in the older parts the ground is now fairly well covered with a layer of moss, pine-leaves

and mould. The absence of hard turf and matted grass is, of course, very favourable to natural reproduction which seems to be extremely easy. The cluster pine is probably indigenous in this part of France, and is eminently suited for the "reboisement" work of the dunes. It possesses a well developed taproot as well as a lateral root system, and this enables it to take firm hold of and fix the sandy soil, also to seek moisture from great depths.

The forest of La Teste being especially valuable commercially on account of its resin production, its treatment has been determined mainly with a view to that object. Owing to the difficulty of transport over the soft sandy roads and the facility with which foreign timber can be obtained by sea, the production of large timber is a matter of secondary consideration. The rotation of the forest of La Teste has, in consequence, been fixed at 60 years, which age is considered sufficient to enable the maximum amount of resin to be obtained, and the Working Plan has therefore been drawn up accordingly. The whole area has been divided up into 12 blocks or affectations, 5 years being allowed for the final working out of each. Each block is divided into 5 compartments of about equal size, in three or four of which thinning operations or final coupes are in progress. During the earlier stages of the forest growth, thinnings are made every 5 years, principally by daily labour, and this continues up to the age of 35 years when the regular thinnings on sale to contractors are commenced. At this age the trees will have attained a mean girth of about 3 feet 6 inches, at which size they are considered fit for tapping. All the trees to be reserved in these coupes are specially marked, and tapped "*à vie*," whereas all the unmarked trees can be tapped "*à mort*," or removed at once by the contractors.

A period of 5 years is allowed to the contractor for tapping the reserved trees and removing the other produce from the coupe. After the completion of the first tapping operation the trees are allowed five years' rest, and then the second tapping takes place, say from 45 to 50 years, and then another rest of 5 years is allowed till the trees attain the age of 55 years, when the final coupe takes place. After careful observations and much discussion it has been decided that the final fellings in this forest shall consist of clear fellings or *coupes à blanc étoc*, and for several years this has been the plan in force.

The main reasons for this rather unusual treatment of pine forests are :—

(*a*) The seed of Pinaster being extremely light is carried to a great distance, and is produced abundantly almost every year.

(*b*) There being little or no grass in the forests the seed can easily reach the soil where it germinates with great facility.

(*c*) The young plants thus produced are said to make much more vigorous growth than those produced under the shade of the parent trees.

In the treatment of this forest an attempt was made by a late Inspector General to adopt the regular system of a heavy seed felling followed after production of the new crop by a final felling, such as was applied to the fellings of Scotch Pine in the forest of Haguenau, but it is said not to have been a success, and has, therefore, been abandoned.

The Forest of La Teste is in charge of a Brigadier and six forest guards.

Fire-protection.—Owing to the dryness of the climate and the inflammable nature of the species these pine forests are extremely liable to conflagrations, and elaborate arrangements have to be made for their fire protection. This renders them, in consequence, extremely instructive to officers about to proceed to India, or on leave therefrom. The arrangement for fire conservancy consists in dividing the 12 blocks across their centres by means of a main fire line 50 feet broad. Also along the outer boundary on the Western side a line of similar dimensions is maintained In addition to this each block is divided into two parts by transverse fire lines, 35 feet wide. Owing to the fact that there is litt.e or no grass in these forests the maintenance of the fire lines is naturally a much simpler operation than in India, and they are said to require sweeping and digging once in two years only. The result of fire protection has not been very successful of late, and in blocks V, VI and VII near Sinaphore, as already stated, we passed through an area of about 1,200 acres, which was the scene of a very disastrous conflagration during May 1893. The fire is said to have commenced in a private forest on the eastern side, and as there was a high wind blowing at the time, it soon crossed the outer fire line. The difficulty of checking the fire was also materially increased by the fact that the burning fir cones are said to have jumped across the line far up in the air, so that when the establishment was combating the fire in front they suddenly found that the conflagration had broken out in their rear. The fire is also stated to have crossed several of the internal fire lines, but was finally extinguished on the third day by means of a counter-fire. The result of the conflagration has been most disastrous, and almost every tree in the area burnt is now dead. A sum of 1,100 francs was paid to the neighbouring villagers for assistance rendered. In several other parts of the forest we noticed burnt patches, so that forest fires in this part of France are apparently of frequent occurrence, especially during a dry season like 1893. The age of the burnt area varies from 20 to 30 years, and all the burnt poles are now being cut up and exported to England and Wales as pit props. It was, however, satisfactory to note that in these forests it invariably happens that after a severe conflagration a splendid crop of seedlings springs up.

Resin-tapping operations.—As explained above, the main object in the treatment of these forests is the production of resin, and the annual coupes are arranged accordingly, and sold with this object in view. At the annual sales the right to tap for resin

the different coupes is sold subject to the following conditions:—

In the compartment being clear cut the contractor can tap "*à mort*" all the trees standing at his disposal, four years being allowed for the tapping and five years for the extraction of the timber. In the other compartments where thinnings are to be executed, the trees to be reserved and tapped "*à vie*" are carefully marked, and the contractor is at liberty to do with the rest as he chooses. He is allowed five years for the tapping and export of the coupe, and it is stipulated that the cuts shall not exceed four inches in width and about 4 in. in depth. During the first year the cut shall not exceed 22 inches in height, the 2nd, 3rd and 4th 20 inches, and the 5th year 40 inches, so that at the end of the five years the total height amounts to 12 feet and 8 inches. He is further charged with the supply of a certain amount of fuel to the forest guards, also to keep the fire lines in order and to supply workmen up to a certain number and value, for works of improvement such as sowings, thinnings, &c., in the neighbouring forests. At the time of my visit, the resin-tapping operations were practically at a stand-still, but we found the workmen still in the forests, and the whole operation was shown to me by them, and they seemed to be very expert in the use of the special tools employed for this work. The method of procedure I found to be exactly in accordance with the explanation given by Colonel Bailey at page 55 of the *Indian Forester* for February 1888, so that further explanation is superfluous here. My observation tended to confirm my opinion that our Indian workmen have still a good deal to learn in the method of collecting and economic storage of the resin, but the use of the heavy axe (*abchotte*) is not likely ever to be adopted by the Indian workmen by whom just as good work is probably done with the native 'bassola.'

At the time of my visit the dry resin or "*barras*" was being collected by means of a kind of scraper called a *barrasquite*, a cloth being spread below the tree to receive the resin as it falls down. This is packed either in the usual barrels containing 520 lbs or in palm leaf baskets containing about 200 lbs. These latter are brought from Algeria or Egypt by the proprietor of the private forest in which we observed them in use.

When collecting the "*barras*" the workmen, as a rule, do not mount the trees by means of the pole ladder, in the use of which they are apparently very expert, but use the hooked "*barrasquite* fixed on a long pole. At the time of my visit nearly all the liquid resin had been conveyed to the factories from the tubs or reservoirs placed along the cart roads in the forests, and the carriage of the "*barras*" was then in progress. It should be noted that the work in these forests is never interrupted by snow, so that carrying work by means of carts can go on all the year round. The State in these forests has arrived at the happy stage of having nothing to do with the collecting or manufacture of the resin, for as the industry has now been established for more than 100 years it is all done by

private enterprise. The collecting in the coupes sold is all done by contract, the workmen being allowed to retain half of the total amount collected both of moist and dry resin during the year, the cost of conveyance being borne by both parties. The average number of cuts which two workmen (generally a man and his wife) can look after is said to vary from 5,000 to 6,000, which represents from 2,500 to 3,000 trees. The price obtained at the auction sales for the right to tap in the forest of La Teste is said to have improved of late years.

Manufacture of resin.—At the village of La Teste I was enabled, through the arrangements made by M. Grandjean, to visit the important and interesting factory of M. Lesca, who is one of the most thriving resin manufacturers in the neighbourhood of Arcachon. M. Lesca was absent at the time of my visit, but his agent kindly showed me over the factory, and explained all matters of interest with regard to the manufacture, a short description of which I shall now endeavour to give :—

The crude resin after being carried from the forests in wooden barrels containing 529 lbs. each is run or scraped out of the casks and then subjected to a careful system of filtration.

If it is in a liquid state at the time of its arrival it is run through straw filters, but if too hard for this treatment it is at once thrown into a large boiler or vat and gradually heated. Here the lighter substances rise to the top and are skimmed off, whereas the heavier ones fall to the bottom, and are afterwards removed. The heating of the crude resin is a most delicate operation, and is said to be the most difficult operation in the whole manufacture, for if heated unequally it is apt to catch fire, &c.

After the resin has become quite liquid it is transferred to another vat by means of ladle and trough, being subject to a further filtering "*en route.*" As the operation of heating and filtering goes on a day in advance of the actual manufacture, two vats, as above described, are kept alternately in operation.

From the second vat, the melted resin is ladled into a small tank of the same capacity as the retort in which it is kept hot till required. From this tank the nearly pure resin is let into the retort by means of a tap from time to time, together with a small quantity of water, and is then subject to distillation in the usual manner. After all the spirit of turpentine has been drawn off from the still, the top hole is opened and the liquid colophony is allowed to run into a filter placed over a heated vat, for even this resin is still found to contain a certain amount of impurity, most of which is caught in a sieve, or falls to the bottom of the vat in the form of a black deposit resembling pitch. This vat is provided with a pipe placed about half way down, through which the liquid colophony again runs into another vat when its manufacture is complete. From this last reservoir the colophony is ladled into large casks containing about 800 lbs.

In order to prevent fraud by dishonest persons who are said to be in the habit of passing off inferior colophony under the name of M. Lesca, he has adopted the plan of placing an iron plate in the liquid colophony with the name of his firm, &c., printed on it, which becoming imbedded can be easily seen when the cask is broken open. Each barrel is numbered and samples taken, which are similarly numbered, and which are kept in a cabinet for reference. All the subsequent sales of each barrel take place in accordance with these samples, and this arrangement obviously prevents all possible misunderstanding between seller and buyer.

As regards the turpentine, it is ladled from the tank placed at the end of the still into a metal barrel mounted on a truck, and is conveyed by means of a light tramway to the turpentine shed, which for safety is situated at some distance from the main factory. Here it is pumped into large metal vats, 10 feet high by about 6 feet in diameter, where it is allowed to settle for some time before being sold. No system of purifying is in practice, and it is sold just as it issues from the still, and is said to be quite pure enough for the ordinary market.

The manufactured colophony is classed into four main classes, *viz.*, spring, summer, autumn and winter, the first being the most transparent and consequently most valuable, and the last, produced mainly from the "barras," being the least so. I was provided with samples of these different classes of resin, the appearance of which varies much.

The outturn in manufactured produce from the crude resin, I was informed, stands, as nearly as possible, thus :—

From a *barrique* or barrel of crude resin which, as already stated, contains 520 lbs., I was informed, that the outturn amounted to 364 lbs. of colophony, 110 lbs. of turpentine and 46 lbs. of refuse.

The prices obtained at the factory for the manufactured produce are as follows :—

1*st*—best quality—12 shillings and 9 pence per 100 lbs.

2*nd*—from 7 shillings and 6 pence, to 7 shillings per 100 lbs.

The turpentine is selling at present at 25 shillings per 100 lbs. This appears to be a slight advance on the prices stated by Col. Bailey at the time of his visit in 1886.

Most of the manufactured produce is taken first to Bordeaux, from whence it is shipped principally to Holland, Belgium, Germany, Italy and England.

Management of Private Forests near Arcachon.—Whilst proceeding to Simaphore we passed through extensive areas of private forest, acquired, as explained in para 5. All these forests, notably that of M. Conseil, are managed mainly from a resin-producing point of view, the trees being tapped in the same manner as in the State forests. The forests are, however, much

younger, and the contractors are apparently not tied down by such strict conditions. Most of these private proprietors, some of whom possess considerable areas of forest, have started their own factories; and these, I was told, are much on the same plan as those of M. Lesca.

The Sand Dunes of La Teste.—On the 2nd December I accompanied M. Grandjean to the great littoral sand dunes, situated to the West of La Teste along the borders of the Bay of Biscay, and he was kind enough to explain all details with regard to their formation, the damage done by them, and the measures taken to prevent their advance. The formation and action of these sand dunes having been so clearly explained by Col. Bailey in the article already referred to, it would be superfluous for me to attempt a fuller description here, and I shall therefore confine my remarks to a few points of interest, which I especially noted.

One of the most important natural elements employed in fixing the loose sand dunes is a grass called gourbet (*Arundo arenaria*), and which much resembles the Bent grass found on the shores of Scotland. The utility of this grass has been more fully taken advantage of during late years by the Forest Officers, and it now plays a most important part in the work of regulating the height of the dunes, checking their advance, and consolidating them.

Along the shore of the Bay of Arcachon we noted that the ravages caused by the drifting sand are by no means so important as along the coast of the Bay of Biscay, where the loose sand is naturally exposed to the full force of the Atlantic gales. In the first part of his charge, therefore, the Forest Officer finds the maintenance of the works of minor importance as compared with those along the Atlantic shore, and they consist principally in the following operations:—

Above high water mark and along the base of the dunes gourbet grass is planted and sown, and the slopes, when in a loose state, are covered over with branches of gorse, broom, &c., which are kept in position by means of heaps of sand piled on their thick ends.

Pine seeds are also sown or plants spring up naturally, and in course of time these banks become gradually consolidated, but, of course, require constant attention. In places where large gaps have been formed by the action of the wind, rows of fascines about 4 feet high are erected, and, as the sanddrifts top them, others are constructed, till the gap is gradually filled up. In some places we saw small faggots placed on end employed in a similar manner to check the drifting sand.

On our way along the shore and near the place where the Bay of Arcachon meets the Bay of Biscay we saw what has taken place in the case of a private proprietor to whom a large area of

State forest was sold some years ago, together with the artificial dune then in good order. Since that time the works have apparently been neglected, so that the great white dune is now steadily advancing landward, at the rate of about 100 feet per annum, and swallowing up a fine pine forest in its steady advance.

The great artificial dune in charge of M. Grandjean extends along the Bay of Biscay from Simaphore as far as the commencement of the Department of the Landes, a distance of about 8 miles, and from this point it extends for about 100 miles more, as far as Bayonne. This work was commenced about 40 years ago in a regular manner, and has proved most successful in checking the rolling sand. It should be noted that, as far as possible, the construction of the artificial dune has been commenced at a point well above high water mark, and a zone of about 500 yards wide has been left along the sea shore which is not interfered with, except so far as the planting and cutting of the gourbet grass goes in certain places. At a place about 2 miles south of Simaphore the sea had, however, commenced to make inroads; and has nearly demolished the whole of the artificial dune for a distance of about 1½ miles. An estimate amounting to about 20,000 francs for the repairing of this breach is being prepared by M. Grandjean, and the work is to be taken in hand at once. The height of the artificial dune is about 40 feet above high water mark, the top about 160 feet wide, and the base of about 300 feet. The dune has principally been constructed by means of the system of movable planks or palisades described by Col. Bailey in his paper already referred to. The slope of the dune on the sea-ward side is from 30 to 40 degrees, whereas on the landward side it varies from 45 to 50 degrees.

One most important point to be attended to is the maintenance of this barrier at a uniform height, and also to prevent its being cut into by the strong westerly gales. This is now being more effectually arranged for by an improved plan of planting the gourbet grass. By a Departmental order it appears that a hard and fast rule was laid down that the grass tufts should only be planted about 1½ feet apart, and no deviation from this rule was permitted under any circumstances whatever. M. Grandjean, however, found that the arrangement had the effect of causing the accumulation of too much sand in some places and allowing too much to pass in others, so that great irregularity of height was the result, a new rule has therefore been sanctioned permitting the officers in charge of such works to regulate in a rational manner the distance apart at which the grass should be planted according to local circumstances, also to cut the old grass where necessary. By this new arrangement the maintenance of the artificial dune is much facilitated, and in the canton of Are, of which M. Grandjean formerly held charge, and which is situated to the north of Arcachon, the annual saving in repairs has been reduced from 40,000 to 20,000 francs.

In marching along the dune we were struck by the fact that the small pines, at the back of the great artificial dune, and in places where they were quite sheltered from the wind, appeared to be in a very stunted condition, whereas the trees situated about ½ a mile off, and subject to the full force of the western gales seemed to be in a much more flourishing state.

This state of affairs is apparently quite contrary to the accepted theory that trees exposed to the perpetual force of the sea breezes always remain stunted and unhealthy, and the reason can apparently be best explained by the assumption that the leaves of the pines close to the sea become cut and choked up by the very small particles of drifting sand, whereas those further off, though exposed to more wind, are not so much subject to this influence.

Concluding remarks.—In concluding this report I beg to offer a few remarks by way of comparison with similar works and forest operations in our Indian forests :—

As regards the area under the charge of M. Grandjean, consisting of about 6,000 acres of State forests, and about a similar extent of Communal Forests, it seems to an Indian Forest Officer ridiculously small. Details of fellings, sowings, maintenance of the artificial dunes and other operations can, therefore, receive much greater personal supervision than can be exercised by Indian Forest Officers to the numerous works of a similar nature going on in some divisions.

Regarding the system of exploitation *à blanc etoc* now universally practiced in the cluster pine forests, I was not quite convinced that the regular system of coupes as applicable to Scotch pine forests, if properly tried, would not give better results, as far as the out-turn of resin goes and the reproduction is concerned. One point seems certain that the thinnings in the State forests are apparently not severe enough, and a much better out-turn of resin would probably be obtained if the trees were more isolated.

As regards the system of tapping the cluster pines, *viz.*, in three long cuts, 12½ feet high, during their successive periods of 5 years with two intervals of 5 years each, I am of opinion that it has no apparent advantage over our present system of tapping Chir in the Jaunsar Division, which consists in making 2 or 3 cuts at the same time, and extending tapping over a period of four to five years after which the tree is abandoned. Our system has certainly the advantage of concentrating work much more in one place, and no great harm is apparently caused to the Chir trees which continue to flourish, although in the case of the cluster pine our system would probably constitute *gemmage à mort*.

An important point, however, has to be noted, *viz.*, that the Chir trees tapped in Jaunsar are on an average from 7 to 8 feet in circumference, whereas the cluster pines rarely exceed half that size.

Regarding the collecting and storing of the resin, I noted many minor points in which improvements in our system are desirable, and which I shall endeavour to carry out in Jaunsar as soon as possible. As a matter of course, the system of selling the right to tap a certain area to a contractor, by whom the work is done by experienced men accustomed to it from their youth, has a great advantage on our present daily-labour tapping system as practiced in Jaunsar, as all details are naturally managed with the greatest economy. If possible, a system of tapping on contract in Jaunsar might now be considered and tried.

Regarding the use of the French tapping tools I am of opinion that they are a great deal too heavy for our workmen, and probably just as good work is done by the hill men with the native 'bussola' to which they are accustomed.

One great advantage the operations in the forests of the Landes enjoy in comparision with Jaunsar is that the carrying work can be accomplished by means of carts, and is not interrupted by rain and snow during five months in the year.

As regards the manufacture of the crude resin into colophony and turpentine, I observed that much greater care is exercised than we have been accustomed to give up to the present, in the matter of separating the resin of the different seasons; also in thoroughly cleaning the melted resin by means of an elaborate system of filtration. It is, of course, evident that this special industry which manufacturers like M. Lesca make their sole business, can be managed much more efficiently and economically on a large scale, than in the case of our small experimental factory at Dehra Dún. As regards the French turpentine it probably contains less acid than our Chir turpentine, but the quality seemed to me to be much the same as that produced at Dehra Dún.

Finally, with regard to the important question as to whether the resin industry, as at present practised in France, is a paying one, I was told that there is generally a keen competition for the coupes at all the annual auction sales. And as regards manufacturing trade, it seems to be in a flourishing condition, at least as far as M. Lesca's business is concerned; and I was told that all the produce of his factory is generally sold long before it is actually manufactured. Judging, too, from the fact that this gentleman is considered to be a very rich man at Arcachon, the French resin industry seems to be a paying one at present.

FEBRUARY, 1895. } E. McA. MOIR.

The Quality of quickly grown Teak-wood.

Mr. Porter in his article "On the management of Forests producing Teak," printed in your *April Number*, has called into question the quality of Nilambur Teak, and has virtually challenged the production of evidence to show that the quality of that grown in the plantations is as good as that of Anamalai Teak. Dr. Nisbet has also in his article on "*the Diseases of Trees*" in the same number, referred to the growth of teak and its attack by fungi on very rich soils. I should like to try and show how it is that I think they are both, to some extent, mistaken.

I must preface by stating that this paper is being written sitting in a dry nullah bed under the trees after a hard morning's walk, and whilst waiting for the sun to go down before returning home in a skin boat. I have therefore to trust to memory, and have but little available time to revise my notes. I trust that due allowance will be made, therefore, for any petty inaccuracy which may occur.

The words in Dr. Nisbet's article, which I specially wish to discuss, are as follows:—

"Though producing a very much quicker growth of teak, 'these alluvial plantations can never be expected to furnish sup-'plies of the finest quality of timber, and if the degree of fertility 'exceeds a certain (indefinite) limit for the given circumstances 'of soil and situation, then it seems almost certain that there will 'be predisposition towards disease either in individual stems or as 'a general characteristic of the whole." This is the theoretical statement which Dr. Nisbet subsequently states is verified by experience, *and he gives his example. Now, what does this ex*ample prove when carefully examined? It proves this, that, if to an excessively fertile soil be joined a want of drainage and a bad treatment (in crowding the individual trees and not permitting a free circulation of air), there is a tendency to disease in teak. I think no one will deny this. Almost every writer that I have studied, Sir D. Brandis in Burmah, Mr. Bourdillon in Travancore and all the various officers who have written about Nilambur have shown, that on a soil which is not well drained, teak will not grow, *or if it does grow the wood produced is of poor quality.* This, I maintain, is not due to the excess fertility of the soil, but to want of drainage. There is a magnificent example of this at Nilambur. One compartment, known as Eddacod 1846 (date of planting) consists of a rich alluvial soil on which there are about 70 trees to the acre, or perhaps more. The quality of the wood is superb, as is shown by certain windfalls which were collected and sold last year realizing nearly Rs. 2 the c.-ft. in the plantation. But in one corner the ground slopes towards the river, and there forms a small plateau, which is flooded nearly every year and on which the water stands. This corner is also planted with teak, and to all appearance the trees are sound, but a careful examination shows them to be hollow to the core. Mr Hadfield will remember a nice log we saw lying on the bank. We wondered why it was not taken with the rest, as from a distance it looked beautiful, but on close examination we found it quite a shell, hollow up to a length of 60 feet.

Now I come to the point that these quickly grown trees do not produce timber of the finest quality. The Nilambur plantations are a standing testimony to the contrary. It is on the richest soils, provided always that the drainage is good, that we expect the best crop. The oldest plantation is now 50 years of age, and stands on a rich alluvium. The measurements in this plan-

tation, as a whole, are given in your March number. I have estimated that the *average girth of 6'-6"* at breast height will be obtained in this plantation in about the 90th year. At present there are no signs of decay, and the timber even of the biggest trees, *which reach 8 feet in girth, is excellent.* The Persian Gulf traders, who are no fools, buy up the big timber of the windfalls with alacrity; whilst the Moplahs, who are shrewd men of business, will offer fancy prices for the bigger trees as they stand. All this is evidence to show that the plantation teak is good timber, though grown fast on a rich soil. But why should this be different to the natural grown timber of the Nilambur Valley which gives some of the much valued Malabar Teak. The teak from Neilikutta and Kareenpoya blocks, though grown on a low-lying, rich alluvial soil has been worked for years, and there are no signs of fungoid decay. On the contrary, except for parasitic growth, the wood would be splendid, and I fancy much must have found its way to the Bombay dockyards. So much for indirect evidence, but we have also direct evidence on the quality of the plantation teak.

In 1876, I think it was, Col. Beddome raised this very question, and on it stopped planting. This annoyed Mr. Ferguson who protested all he knew. Canny Scot that he was, he was not *going to have this improved argument shoved down his throat.* He sent specimens cut from the plantations of about 30 years old (and you may be sure they were from the quickest grown trees as he was so proud of them) to the Superintendant of the Gun Carriage Factory to be tested with Malabar (natural grown), Anamalai and Pegu wood. The result was as follows :—

In order of density came—(1) Anaimalai, (2) Malabar, (natural), (3) Nilambur, (4) Pegu. In order of resisting strain—(1) *Malabar, (2) Nilambur, (3) Anamalai, (4) Pegu.* Considering the specimens sent were young timber, I do not think that the trial showed that the plantation teak was not of the finest quality, and the Superintendent's certificate was very favourable.

Specimens were also sent to the Paris Exhibition, where they were much admired, and *no fault was found with the quality of* the wood.

I think, from what I have noted, it may fairly be urged that Dr. Nisbet's statement as regards plantation teak on rich soils is not borne out, in the case of Nilambur at any rate; and that Mr. Porter's suspicions as regards the quality of Nilambur teak, are groundless.

COIMBATORE DISTRICT,
8th May, 1895. } P. M. LUSHINGTON.

Walking-sticks and Umbrella-handles from New South Wales.

A couple of years ago I issued the circular referred to below to personal friends and correspondents. I received a number of valuable replies in consequence. Through the pages of the *Gazette* I am enabled to appeal to a wider audience, and I beg to bring the subject under the notice of its readers.

Walking-sticks, canes, umbrella-handles, &c., of one sort or another are always in demand. At present, although we import a very large number of finished sticks, our quota to the world's supply of raw sticks is mainly limited to a few Mitchenbilla* or Walking-stick Palms *(Kentia monostachya)*. It is a matter of everyday remark that sticks of useful or ornamental character are noticed in the bush, and are either passed by or cut down for temporary use and then cast away. But in the ornamental or curiously-shaped sticks that we so often see in the bush, I see a prospective minor industry. The collecting of sticks is not going to rival gold-mining, but the accumulation of them at odd times (like the gathering of certain gums and resins), will be remunerative as soon as our people have learnt how and what to collect. Sticks of the kind required will not take up much room, nor are they objectionable in any way. If each family in the bush can make just a few pounds a year out of sticks, it will be with no interference with the ordinary duties of each member; but it only leads to disappointment if sticks be gathered without reference to what will probably be required, and therefore the hints which follow are commended to careful consideration.

[Circular.]

I am collecting information in regard to the suitability and availableness of Australian saplings and timbers for walking sticks, umbrella and parasol handles, and I shall be grateful if you will help me in the inquiry.

I have jotted down the following general notes re walking-sticks. They should possess :—

(*a*) Rigidity.
(*b*) Strength
(*c*) A good root or excrescence to form a handle.

Weight is not material. Straightness is not absolutely essential as any sticks can be straightened by suitable processes. They should taper to the end. There should be facilities for collection and shipping, as they would require to be delivered at the port of shipment at a very low rate.

Sticks are of two kinds :—

1. Those cut out from the solid, *e. g.*, Forest Oak, Native Pear, Blackwood, Red Ironbark, and the outer portion of the stem of the Cabbage Palm.

* *Vide* note, P. 244.

2. Saplings, such as Tea-trees, Wattles, small Palms, and innumerable others. It is to this class that we should mainly look for suitable sticks.

There are innumerable kinds of suitable saplings to be obtained, and, they might be procured at odd times by children and others, kept until a fair number accumulate, and then disposed of.

Peculiar sticks, such as saplings with twiners round them, are desirable

In the course of this inquiry I put myself into communication with Messrs. Henry Howell and Cy., cane and stick manufacturers, of 180, Old-street, London, E. C., who are well known to be far and away the largest firm in the trade. I found that this firm had published some hints on the subject, and the following is a copy of their circular :

POINTS TO BE OBSERVED IN COLLECTING RAW STICKS, CANES, &c., FOR WALKING-STICKS, UMBRELLA HANDLES, &c.

Length.—The total length should not be less than 42 inches, end to end, but if possible they should be 48 inches.

Size.—The best sizes are of the diameter of ½ inch to 1 inch, measured about *midway* ; they should not be larger than 1¼ inches in diameter.

Form.—It is indispensable that the diameter should gradually diminish from the root or handle to the point, so that the stick is not "top-heavy."

Handle.—It is always better, when possible, to send sticks with some kind of handle ; if the plant be pulled up, the root should be left quite rough and untrimmed ; if a branch be cut off, a part of the parent branch should be left on to form a knob or crutch handle.

Sticks without handle.—Sticks without handle can be used, especially if they are nicely grown, and have any peculiarity of structure or colour —but if there is any handle, however small, it should not be cut off. Young saplings of the different kinds of palms, bamboos, &c, &c., should always have the root left on.

Short handles. -Occasionally, the form of the root or handle part is attractive, while the stick itself is weak and defective ; in such cases the handles only should be sent, and they should measure from 15 to 18 inches in length

Send only specimens in first instance. -In sending specimens of new sticks it is better to send only small quantities, say, one or two dozen of each kind ; then, if approved, further quantities can be asked for.

All kinds of wood.—Specimens of anything remarkable for form or colour, whether in the roots or stems of woody, herbaceous, or reedy structures should be sent, as sometimes the most unlikely things are found to possess value for use either as umbrella handles or walking sticks.

Details.—Details as to quantity to be procured, prices, &c., should be sent, if possible.

I addressed a number of questions to Messrs. Howell and Co., and perhaps it will be better to quote their reply as fully as possible : —"The subject to which you refer, *viz.*, 'the collection of 'raw sticks suitable for walking-sticks or umbrella handles,' is one "in which we need hardly say we are particularly interested, and

'we are very much obliged to you for the way in which you are 'endeavouring to bring it before the people in Australia. From time 'to time we have seen sticks from the different colonies of Australia, 'and there has been a considerable quantity of one or two varieties 'sold in this market, the principal one being the midgeon* cane which 'we believe came from the neighbourhood of Brisbane. In an article 'in the *Gardener's Chronicle* of 27th January and 3rd February, '1877, written by Mr. J.R. Jackson, curator of the Kew Museums, 'that gentleman gives a list of sticks from Australia, amongst which 'he mentions the Cardwell cane (a species of *Calamus*), also the 'Loya,† apparently of some species of Calamus or rattan, but of 'very small diameter, and with fantastic roots; there is also the 'bramble, which possesses a root something like a potato, and which 'grows to a pretty good size, but none of these canes seem to have 'met with any success beyond the Midgeon, and unfortunately this 'has gone completely out of fashion, so that at the present time it 'is a complete dead letter in the market. We think, however, 'that there must be a very large number of plants which would be 'suitable either for walking-sticks or for the handles of sunshades 'or umbrellas, and if you could succeed in getting any intelligent 'collector to send us samples, we should be very glad to give our 'opinion as to their value, and if we saw any chance of using them, 'to give orders for a sample parcel in order to try the market. The 'present time is peculiarly suitable for the introduction of some new 'articles of this character, as the staple sticks now in use have had 'their day, and the trade generally would be glad of something 'new. It is, however, quite a mistake to suppose that any kind of 'stick possesses a value; it is essential there should be some pecu-'liarity in the sticks themselves, which will render them attractive, 'otherwise they are reckoned almost as firewood, the price realised 'for which would not suffice to pay the freight. In other words, 'we should not want firewood sent from Australia."

"We note with much interest your printed circular in regard 'to the collection of these goods, and we must say that you have 'indicated with remarkable exactness the class of goods which 'would be likely to prove most useful in the market here, and con-'sequently of commercial value. Especially is this the case with 'the description you give under No. 2, *viz.*, saplings such as tea-'trees, wattles, small palms, &c. We think that something new in 'palms or natural saplings would be more than anything else likely 'to meet with demand here. Sticks cut from the solid, unless 'having a peculiar marking like figured ebony, palmyra, letter-'wood (or snake-wood of British Guiana) do not seem to meet with 'any favour. We should like, however, to see a specimen of the

* *Kentia or Bacularia monostachya*, the Midginbill or Mitchenbill or Walk-stick Palm of our northern rivers (N.S.W.), and usually known in Queensland as the Midgeen Cane.

† (?) A corruption of Lawyer.

'stem of the cabbage-palm. If the outer hard portion should be of 'sufficient thickness to make a rigid stick, we think there will be a 'good deal of character in it. Of course it is understood that our 'sticks are finished, and consequently are very much smaller, espe- 'cially in the handle part, than they would be in the rough state. 'We like all sticks sent untrimmed, the root or handle part left as 'large as possible, so that we may use our own discretion as to the 'form of handle we may make. *The round hook sticks, you will* 'easily understand, are artificially bent, so that it does not follow 'that all sticks without handles are valueless, provided they possess 'some distinctive character, so as to be of use either for bending, or 'having artificial heads put on them. Seeing that they are usually 'sent with the bark on, which has often to be removed, the size of 'the sticks should be about 1 inch in diameter, measured about 'midway.

"As to the kinds of wood which can be used in our trade, 'it will be sufficient to point out that large quantities of mullein '(*Verbascum*), teasel (*Dipsacus*), as well as certain kinds of Cacti, 'the woody structure of which presents a very remarkable appear- 'ance when cleared of the fleshy matter which is so abundant on 'this plant, have been employed as sunshade handles, and they make 'a very light and graceful handle. We think it would be well if 'you could get some person to interest himself sufficiently to study 'the matter, and to send us about a dozen of each specimen of wood 'which seems at all likely to be useful, taking care to keep dupli- 'cates of the same properly numbered, so that in the event of an 'order being given there might be no doubt as to their *identification*, 'and as to what is required. If they are addressed to us, we will give 'a prompt reply as to the kinds which might be utilised. We 'think it is as well to mention that it is most unadvisable for any 'large quantity of sticks to be sent away unless they are properly 'selected to suit the market. We have known several instances of 'persons having done this who have invariably lost money by it. 'To sum up the matter, we may say that we should like to see 'specimens of every kind of palm which can be obtained in Austra- 'lia, *also anything of an herbaceous character, having, when dry,* 'sufficient rigidity to carry a sunshade. In addition, any kind of 'wood which possesses any kind of 'figure' on the surface of the 'bark, or on the wood immediately under the bark. We have used 'an enormous quantity of English furze (*Genista*) lately. This, as 'you know, is very peculiar in its structure, having holes and knots 'in the wood, which when finished present a very distinctive ap- 'pearance. Anything of the 'Genista' type we should think would 'be likely to be of some use. Some time ago we saw some sticks 'purporting to come from Australia, called the 'Australian Bay.' 'It had a peculiar nutty brown bark when dry, with *longitudinal* 'indentations, and was inclined to be somewhat flat or square-sided, 'rather than rotund. A stick of this kind, if it could be obtained 'with a good handle, would certainly be of some value here. In

'reference to the prices and quantities of sticks which might be 'imported, you will see from observations that it is impossible to 'furnish this information until we have seen the woods and been 'able to form some idea as to their value."

In a list of sticks supplied to the London market, I find that small saplings of Tasmanian Blue-gum (*Eucalyptus Globulus*) are supplied by Algeria, and none from Australia. Orange and lemon sticks are supplied by Algeria and the West Indies. Surely we could supply these as cheaply as anywhere else.

The variety of sticks we could supply with our remarkably rich vegetation should be unusually great. The industry seems to be full of bright possibilities, but, as this article has already exceeded the length I had intended, I will defer any further remarks to a future issue of the *Gazette*.

No doubt many gentlemen who do not desire to enter into the collection of sticks themselves will be able to furnish the Department with valuable information, which will further the industry as far as this Colony is concerned. In such cases, letters addressed to the Under Secretary for Mines and Agriculture will receive careful consideration. Those who are prepared to embark in the industry at once, or who have accumulated specimens of what they deem to be suitable sticks, are recommended to communicate with Messrs. Henry Howell & Co., direct, at the address given above. *(J. H. Maiden, in a paper published by the Department of Agriculture, N. S. Wales).*

Consumption of Timber in the British Isles.

The following is an abridged translation of a paper by Monsieur A. Mélard in the number of the *Revue des Eaux et Forêts*, of the 10th of December, 1894.

It has frequently been imagined that the increasing consumption of iron and steel has reduced the demands for timber, so that some people look on complacently while forests are cut down or deprived of their large timber ; the present paper has therefore been written in order to show the incorrectness of such an opinion.

The British Isles are the chief iron-producing country in Europe, as the following table shows :—

ANNUAL PRODUCTION OF PIG-IRON IN THOUSANDS OF TONS.

(The French ton is about 1-20th in excess of the English ton.)

British Isles, 1893		...	...	6,830
Germany, 1891	...	...	...	4,404
France, 1893	...	...	...	2,010
Belgium, 1889	...	...	...	832

Russia, 1888	...	...	...	667
Austria, 1892	...	.	...	631
Sweden, 1892	...	...	...	486
Spain, 1886	...	...	...	148
Italy, 1892	..	...	...	13

Thus Britain produces nearly as much pig-iron as all Europe combined.

If, therefore, the production of iron can reduce the demands for timber, this must be most evident in the British Isles, which is far from being the case, the consumption of wood in Britain having, on the contrary, largely increased. As only a small area, about 3,000,000 acres, is under forest in the British Isles, and the timber required there is *chiefly imported from abroad, the variation* of the timber imports is a measure of its consumption in Britain. These imports have risen from 2,727,000 loads of 50 cubic feet, in 1860, to 7,212,000 loads in 1890, the increase being 168 per cent.; whilst the total imports of all kinds into the British Isles, during this period, has increased only from £375,000,000 to £749,000,000, or by 100 per cent.

Most of the imported timber is in squared logs, planks and scantling, and is, therefore, only about four-fifths of the standing timber from which it is taken, so that the quantity of the latter required for the imports of timber into Britain in 1890 was about 9,000,000 loads. This figure must be extremely encouraging to the forest-owners who supply the British markets, and give them full confidence of finding a good sale for their produce. They may anxiously ask, on the other hand, whether their forests can possibly meet such an enormous demand, and to give a clearer idea on this subject the following figures are given :—

According to a recent public statistical (a translation of this paper appeared in *Nature*) account of the yield of the 7,000,000 acres of French forests which are managed by the State Forest Department, the yield in 1892, exclusive of firewood, was 5,300,000 loads, or about $\frac{3}{4}$ load per acre. The imports of timber into Britain at this rate require, in round numbers, 12,000,000 acres of forest for their production, and only 1·1 per cent. of this timber is re-exported from Britain.

The French share in the British timber imports has risen in value from £430,000 in 1881, to £950,000 in 1893, being about half the total of French timber exports, the quantity of standing timber, to supply which amounted to 648,000 loads. France, however, imports on the average 2,892,000 loads, or, deducting her exports about $2\frac{1}{2}$ million loads annually is the deficit in standing timber, which her forests fail to supply.

Britain is now the best timber customer France possesses, and in 1893 received from her the following imports :—

Timber in logs, &c.	...	...	£441,200
Mine-props	...	...	£422,600
Hoop-wood	...	...	£52,280
Cork	...	...	£21,560
Miscellaneous	...	...	£12,360
Total ...	...	...	£950,000

The rate of increase in the mine-props exported from France to Britain has increased most remarkably. Before 1870, this trade was quite insignificant, but has steadily increased from £32,000 in 1870, to £422,600 in 1893, consequent on an increased production of coal in Britain from 112,125 000 tons in 1870, to 188,437,000 tons in 1891.

Anyone acquainted with the timber trade knows that the large increase of its bulk in Britain has not been accompanied by any increase in price, but by a fall of 29 per cent. in 1893 compared with prices during the period 1867-77, when they reached their maximum. The explanation of this fall in the price of timber, in spite of an increase in the quantity imported, is due to the great bulk and weight of timber, the price of which from distant countries, is largely made up by the cost of transport.

Without considering the great extension of European and American Railways since 1870, marine freights have fallen by 50 per cent. In Britian, according to Sir T. Sutherland, the president of the P. and O. Company, there are now more ships than are actually required, the British mercantile fleet having increased between 1885-1891, from 7,430,000 to 8,279,000 tons.

These reduced freight-charges enable remote countries to compete in the European timber market, and the price of timber is consequently reduced.

As, however, we are dealing with a substance, the demands for which are steadily increasing, while the supply is diminishing, for private owners are everywhere steadily destroying their forests, there can be no doubt of a speedy recovery in the price of timber. Twenty or thirty years of bad prices are disastrous to individuals, but are nothing in the life of a nation. France may, therefore, be confident in the future and continue to preserve her forests of oak, beech, and silver-fir, for the use of future generations.

As to the industries which use up timber in Britain, besides the enormous annual demand for railway sleepers and mining pit-props, there is a large demand for wood for the construction of railway carriages, both for home use and export, £2,240,000 worth of railway carriages having been exported from Britain between 1889 and 1891.

During 1891-1893 more than 1,000,000 tons of shipping was constructed, more than the whole French commercial fleet. The interior of these ships consumes large quantities of timber.

Between 1882-92, the population of the British Isles has increased by about 3,000,000, and the building of new houses employs large quantities of wood.

Britain has imported annually during 1886-91, £611,200 worth of staves for barrels and casks. There is not a single industry which does not use more or less wood for the frame-work of its machinery, or as raw material.

The annual exports from Britain are valued at £240,000,000, and include a great number of fabrics which must be carefully packed for safe despatch to all quarters of the world, so that packing-cases alone absorb large quantities of wood.

Under the circumstances reported by M. Mélard, I am certainly of opinion that owners of land unsuitable for farming need not fear to plant quickly growing timber, while the Crown forests of Britain should be made to yield their utmost in valuable oak, ash, larch, and other timber suitable to the locality. M. Melard has under-estimated the production of an acre of forest in France, which he put at 1 5th of a load, and the correct figure ¾ load has been substituted In Britain, at least, one load per acre can be produced annually.—(*W. R. Fisher in 'Commerce,' 27th March, 1895*)

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Babul in Guntur.

The taluk of Guntur in the Kistna District is as nearly devoid of *forest growth as it is possible to be. With the exception* of half a dozen very nearly denuded small hills there is nothing capable of being converted into Forest Reserves except some areas of babul growing on black cotton soil.

Six patches of babul were selected originally by Messrs. Boileau and Homfray with the idea that they would be useful for the Southern Mahratta Railway fuel supply,—that railway (under the name of Bellary-Kistna State Railway) being, at the time of selection, under construction.

These six patches were therefore notified for forest reserves, and have since been settled as follows :—

Nidamarru Block i A & B, ii, iii	393	acres.
Kurugallu ...	1,305	„
Gollamudi ...	194	„
Kolakaluv Block i, ii	1,356	„
Narakodur Block i, ii, iii	515	„
Lám Block i, ii	1,077	„
Total	4,840	acres.

The settlement unfortunately has reduced what appeared to be six fairly compact reserves into 12 somewhat multi-angular blocks, and this, of course, increases the expenditure in demarcation and upkeep of boundaries.

The original object for which the Reserves were formed has fallen through, for the Southern Mahratta Railway now uses Singareni coal. But there are several cotton ginning mills in the neighbourhood, some at Guntur and one at Mangalagiri ; *and seeing that the Municipalities of Guntur* and *Bezvada* are only 13 and 22 miles from the furthest points of these six reserves, and that there are other large villages, (the largest of which is Mangalagiri) within the circle, the centre of which is Nambur,

(half way between Guntur and Bezvada,) and the radius is the distance to the furthest point of any of the Reserves, about seven miles, there is no difficulty in disposing of the wood.

Mr. Alwar Chetty, late District Forest officer of Kistna, proposed making a working plan for the whole of these six Reserves, on the simple principle of clean felling, with a rotation of 20 years for the whole area. The present District Forest officer made out this working plan ; but substituted 'coppice under standards' for 'simple coppice,' retaining only 5 to 6 standards per acre to provide larger wood for agricultural implements.

The working plan has been sanctioned and has been in operation now for two years. The order of felling adopted is that given above in the list of Reserves, as the ages of the trees in the areas were estimated to vary between 18 years old in Nidamarru and 10 years in Lám Reserve. The areas of the first two coupes were 265 and 228 acres respectively ; coupe 1 being Nidamarru Reserve, Block 1 A and B, and coupe 2 being Nidamarru Reserve, Blocks II and III, and 100 acres of Kurugallu Reserve divided off by a right of way.

Tenders were called for for the purchase of the wood standing, at so much a ton (*the usual method of purchase in the* District). The tonnage was determined by means of sample acres chosen alternately by the District forest officer and the contractor, the average tonnage per acre was found out from them ; and that tonnage, multiplied by the number of acres in the coupe, gave the total number of tons to be paid for.

In the first coupe of 265 acres, six sample areas were taken, two of five acres each and four of $2\frac{1}{2}$ acres each, or a sample of $7\frac{1}{2}$ per cent. of the whole. In the second coupe, eight sample areas of $2\frac{1}{2}$ acres each were taken, or a sample of $8\frac{3}{4}$ per cent. of the whole.

The first year we obtained a tender of Rs. 2-4-0 per ton for wood over 2 in. in diameter, and a lump sum of Rs. 100 for all small wood and thorns, also Rs. 100 for babul pods, and Rs. 65 for grazing ; the second year we received Rs. 2-4 per ton for wood over 2 in. in diameter, Rs. 0-8-0 per ton for wood under 2 in. in diameter, As. 10 per 100 yoke loads of thorns (0·89 tons), *i.e.*, As. 8-11 per ton, *and Rs. 86 grazing and minor produce, so the revenue* derived was nearly Rs. 3,700 the first, and Rs. 2,700 the second, year; or an average of Rs. 3,200 per annum.

Babul trees of 4 ft. girth are worth in this taluk about Rs. 3 to Rs. 5 each : so, as we have left from 5 to 6 standards, half grown, per acre, so that at the second rotation the value should be increased by, say :

5 Trees per acre over 242 acres, @ Rs. 3 each = Rs. 3,630 per annum.

The following table shows the results :—

Coupe No.	RESERVE: Name.	RESERVE: Block	Area of Sample A	No. of Trees: Per Sample	No. of Trees: Per Acre	Tons of Wood, Per Sample: Over 2" diam	Tons of Wood, Per Sample: Under 2" diam	Tons of Wood, Per Sample: Total	Tons of Wood, Per Acre: Over 2" diam	Tons of Wood, Per Acre: Under 2" diam	Tons of Wood, Per Acre: Total	Tons of Thorns: Per Sample	Tons of Thorns: Per Acre	Remarks.
1	Nidamarru	I A	5	413	83	31·3	11·3	42·6	6·26	1·26	7·52	4·46	0·89	
	"	"	2½	346	138	21·7	8·3	30·0	8·68	3·32	12·00	2·23	0·89	
	"	"	2½	231	92	8·0	2·7	10·7	3·20	1·08	4·28	1·24	0·53	
	"	"	2½	74	30	6·5	1·5	8·0	2·60	0·60	3·20	·69	0·36	
	"	I B	2½	205	82	17·1	5·9	23·0	6·84	2·36	9·20	2·89	1·16	
	"	"	5	640	128	37·4	10·6	48·0	7·48	2·12	9·60	3·12	0·62	
	Total		20	1,909	536	122·0	40·3	162·3	35·06	10·74	45·80	14·88	24·45	
	Average per acre				92·16		..	..	5·59	1·79	[illegible]·62		0·74	
2	Nidamarru	II	2½	a.	a	0·80	0·60	1·40	0·32	0·24	0·56	1·15	0·46	
	"	"	2½	..	..	14·40	3·50	17·90	5·76	1·40	7·16	0·45	0·18	
	"	III	2½			6·59	1·46	8·05	2·61	0·58	3·22	0·40	0·16	a not recorded
	Kurugalli	"	2½		..	13·24	3·77	17·01	5·30	1·51	6·81	0·49	[illegible]	* Four separate samples were taken here, but details for each sample were not given.
		"	10*			69·30	16·04	85·34	6·93	1·60	8·53	2·10	0·21	
			20	..		102·33	35·37	127·70	20·95	5·33	26·28	4·50	1·17	
			..		..	..	.		4·19	1·07	5·26	..	0·23	
	Average for the 2 years			.	..	.		..	5·01	1·43	6·44		0·40	

A few other statistics were collected by the writer when measuring up the sample acres of the first coupe.

A large number of cross sections were examined with a view to compare the number of annual rings with the diametric measure-

ments, with the following results :—

Diameter in inches.	Average No. of annual Rings.	Which gives.	No. of years growth.	Girth in inches.	
2"	8·0	...	...	...	Note :—The sapwood varied from 3 to 6 rings in thickness.
3"	13·6	...	10	7"·1	
4"	14·0	..	15	13"·9	
5"	15·6	...	20	19"·4	
6"	18·0	...	25	24"·9	
7"	22·3	...	30	34"·1	
8"	25·0	.	35	42"·2	
9"	26·2	...	...	...	
12"	31·0	...	...	...	
15"	36·0	...	..	...	

Another experiment that was undertaken was to find a reducing factor. Now in the case of babul it is difficult to take measurements breast high as the tree is so very apt to branch near its base ; so it was determined to find a reducing factor for the girth measurements taken 6 inches from the ground.

In the first sample area the sizes of stumps were as follows, and the cubic contents shown below them are as if the trees were taken as a cylinder with the basal measurements as the mean measurement. It was easier when the trees were felled to take the diameters rather than the girths, but in calculating the cubic contents the diameters have been reduced to girth :—

MEASUREMENTS IN S. F. No. 1.

Diameter of Stumps	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	11 in.	12 in.	
Average height of tree	18 ft.	19 ft.	20 ft.	21 ft.	22 ft.	23 ft.	24 ft.	25 ft.	26 ft.	28 ft.	Total
No. of stumps in S. A. No. 1	29	35	86	93	54	57	20	10	2	7	413 trees
Cubic contents	20·13	71 65	164.17	301·05	240·53	359·27	165·49	107·09	26·94	120.91	1507·33 ct.

Now it was found by a series of measurements and weighings that an average cubic foot of wood was 74 lbs., varying between 99 lbs., for a large piece of heartwood and 49 lbs. for a piece under 2 inches diameter.

The weight of the wood if taken above as a cylinder would therefore be $\frac{1507\cdot34 \text{ by } 74}{2240}$ tons = 53·10 tons ; but the weight as found by actual weighing came to—

Wood over 2" diameter + Wood under 2" diameter + Thorns

31·30 + 11·30 + 4·46 = 47 06 tons.

Therefore the reducing factor is—.

$\frac{47\ 06}{53\ 10} = 0{\cdot}8862$ if we take it after squaring the quarter girth or

$\sqrt{0{\cdot}8862} = 0{\cdot}94$ if we take it as a multiplier of the girth, taken at 6 inches from the ground.

As regards the reproduction from the babul stumps, it was fairly good About 1 out of every three reproduced by coppice shoots, in places the reproduction was even better—1 out of every two stools. Besides this there were numerous seedlings everywhere, in *some places so thick* as to form a regular carpet, but this was exceptional. The height of the coppice shoots after a felling one year back was from 2 to 5 feet, about 2½ feet on the average ; after a felling of two years back they were on the average between 5 and 6 feet *high*.

It may be remarked that the area under babul is generally submerged for 3 or 4 months every year by floods from the Kistna River as the land lies low ; and one of the chief difficulties to contend with is the short duration of time to cut and remove the wood ; for the soil, being black cotton, is extremely heavy if at all damp.

A. W. LUSHINGTON.

Tea in the Upper Chindwin.

The following is a list of the villages of the Upper Chindwin which export tea seeds, the inhabitants of all being Shans: – Kaungkan, Tingin, Kawya, Maungkan, Tason, Onbet, Mainwe, Tamanthe, Malin.

Tradition says that these *kins* (clearings) were cleared and planted some 200 years ago, the seed having been brought from Palaung (Northern Shan States). No one has ever heard of wild tea in the jungle; nor have I ever come across wild tea in the forests, in spite of having always kept a very sharp look out for it, and it is my opinion that the tea plant is not wild, at any rate west of the Irrawaddy (by the way, wild cinnamon [*C. Zeylanicum*] has been found by me fairly common in the evergreen forests of the Uyu).

The gardens were originally planted for the sake of the leaves, that is, to make *letpet*, the so-called pickled tea of Burma. However, some 20 years ago there arose a demand for the seed, at first intermittent, but since British occupation steady, and this has now become the main source of income to the owners, though the pickled tea is still collected and made as of old.

The first thing to be done in planting a *letpet-kin* is to find the right kind of soil, what is known as myeni, literally red earth. In this soil the tea-tree flourishes to perfection; the look of this earth is very characteristic, being a light red or buff-coloured fri-

able loam, which occurs in patches, and wherever these patches of red earth are found on the banks of the Chindwin there villages have been built and tea planted. The jungle being cleared of all brushwood and undergrowth, 3 or 4 seeds are dibbled into holes, the holes being either 2 or 4 cubits apart. The object of dibbling in more than one seed is to guard against blanks; however, all the seeds that germinate are allowed to grow. After the plants come up all the tending the gardens receive is periodical clearing of grass, small plants, weeds, and brushwood; the ground is never hoed, nor are the plants pruned, except when the ravages of a parasite known as *chibaung** have become so extensive as to kill the portions above ground, the dead tops are then hacked down with the ordinary Burmese dama, the plant at once throwing up stool shoots or root-suckers which in three years take the place of the old cut down plant. The small plants become large enough to give a crop of leaves in 3 years if the *kin* is kept free of jungle, but not till 5 years if the garden is dirty. Seed is borne when the plants are 8 years old, but they do not come into full bearing till 15 years of age, the normal existence of a tree being 40 to 50 years if not attacked by the parasite mentioned above. Some trees last longer than this, but old trees do not bear such good crops of seeds or leaves as middle-aged ones, being usually stagheaded, and are generally cut down, their places being taken by vigorous shoots thrown up by the stools, some stools as large as 3 feet in girth being seen. A light shade is beneficial to the plants and lessens the labour of keeping the gardens clean, as the shade kills out the rank grasses such as *thekke*, &c., which spring up if there is no shade. Heavy rains are not good for the seed crop, as the seed drops off without ripening; however, if the seed-crop is poor the leaf-crop is usually good and *vice versâ*.

Each house owns from one to three *kins*, the various properties being bounded by rough cactus hedges.

As already stated there are two kinds of crops—the leaf-crop and the seed-crop, (*a*) *The leaf-crop*.—The trees flush three times a year in—(1) Tagu to Kason (April—May); (2) Wazo to Waganng (July—August); and (3) Towthalin to Thadingyut (September—October). Of these three flushes the first gives the *best leaf and brings the highest prices*. *The method of plucking* is to pluck the whole shoot except one leaf which is left. Thus if there are three leaves in a shoot the shoot is nipped off just below the second leaf. Each owner then takes his crop of leaves and throws it into an iron cauldron†, full of boiling water; it is left in this water till the leaves turn a yellow colour; the water is then thrown away and the leaves rolled by hand on mats; it is then ready to be sold to traders, who take it away either packed in bamboo crates or in the internode of the *myetsangye* bamboo

* Loranthus Sp.

† The ordinary Do of Burma, exactly the same as that which catch boilers use for catch boiling.

(*Dendrocalamus Hamiltonii*). If one wanted to keep this tea it must either be kept buried in the ground, or the crates and bamboos must be kept in water. Kawya village, which has the largest extent of *kins*, makes on the average 20,000 viss of *letpet* annually. The price at the village for the produce of the first flush is usually *Rs. 16 per 100 viss, for the other and later flushes Rs. 12-8-0* per 100 viss.

The seed-crop ripens in October and November; it is then collected, dried in the sun, and sold to Burmese traders, who come up for it. The trader shoots the seed into the bottom of his boat, the bottom being roughly lined with mats, and then takes it down to Kettha or Tonhe; where he sells it to the native agents of "tea-seed chiefs."

The price of the tea seed on the garden varies from Rs. 3 to Rs. 10 per basket, but to understand the method of buying the seed one must bear in mind that the trader, always a Burman, comes up in January or February to bargain for the seed crop of the following November. If possible, the trader makes a contract that the owner will sell him all the produce of the garden for a fixed sum per basket. Thus in January 1894 the Maungkan villagers contracted to sell all their seed at Rs. 5 a basket. The trader then advances on the condition that, if the villagers cannot pay him back in tea-seed, they must pay him 100 per cent. on his money. If the trader cannot get a contract for the whole crop he always manages to make advances for a certain proportion of the crop on the same condition. Thus, this year, all the villagers of Kawya have had advances on the condition that they pay back next November (in seed), each basket to be counted as Rs. 3. Any left after the villagers have paid back their advances usually brings double the contract price. The trader then hires boats and takes the seed to Kettha or Tonhe, the rate of boat hire being from 2 annas to 4 annas per basket according to distance to Kettha. He will sell to agents of the tea planter for an average of Rs. 17 per maung (a maung—1 basket 10 pyis or 26 pyis). This is practically the end of the business as far as Burma is concerned, as from here it is carried by Chin or Manipuri coolies in baskets, Scotch fish-wife fashion, to Manipur. No tax is collected or any transit dues exacted anywhere along the route. The Chins are said to carry a load of one basket and a quarter, the average weight of one basket being 14 viss, and get Rs 5 to Rs. 6 for the journey.

It will be seen that as in most trades the middlemen are the best off and absorb most of the profit. The Burman trader makes, even if he does not go in for the advance system, over cent. per cent., and of course his profits are doubled if he does. No Thaungdut coolies or men in any way are interested in the trade, the development of which is solely due to the Bengalis and Burmans. I believe Messrs. The Bombay Burma Trading Company are experimenting as to the feasibility of sending seed to

Assam *via* Calcutta; of course if they succeed that will settle all matters of transit dues both for Thaungdut and Manipur. I see no reason why the Bombay Burma should not succeed as no care to prevent shaking, the effects of damp or of heat, is taken, any way prior to the seed reaching Manipur, by the present method which seems to be as unscientific as possible, and yet the tea-seed has, as is well-known, a first class reputation in Assam for germinating properties. The tea-seed experimented with, however, I would recommend being bought at any cost in November; the best way, of course, would be to advance money on the following season's crop, this system being the custom; or else only the leavings and old seeds which have been lying about can be got, which naturally would not have the same germinating power as fresh ripe seed.

From what I saw of the gardens they were wonderfully healthy considering the little care taken with them, as, with the exception of the parasite referred to, the trees all seemed clean, vigorous, and full of leaf. I should say tea-planting with European methods would be a great success if only the labour question could be successfully dealt with. That once-settled, all a planter who proposed planting in the Chindwin would have to do would be to prospect for red earth, and from my own experience of the forests I am sure I have come across several tracts of similar earth to that on which the tea is grown.

There are two other points to be touched on, *viz.*, a "maung" weight is spoken of above; this I am pretty sure is only a corruption, or rather the Burmese pronunciation of the word maund. I was informed that a "Maung" weighed about 22¾ viss (viss = 3 68 lbs.) and that would bring the "Maung" to about 80 lbs, *i.e.*, the Bazaar maund of India.

2ndly, I believe some people still doubt that "Letpet" the pickled tea of Burma is made from *C. Theifera*; the plant in the Chindwin and Katha is undoubtedly *C. Theifera*, and is not Elocdendron; and it seems absurd that such a point should need proof, considering most of the gardens in Assam have had all their extensions for some years planted with plants grown from Chindwin seed. Besides this Mr. Oliver sent specimens in 1892 to Calcutta which were identified as *C. Theifera*.

C. W. A. BRUCE,
Div. Forest Officer, Upper Chindwin.

Good and bad Turpentine.

We reprint the following extract :—"India is rich in trees 'that might be made to yield turpentine and resin—and imports 'turpentine from America. On its way out *viâ* England it is 'largely doctered with kerosine, naphtha and benzoine. When 'it gets to India it is further improved upon in the bazar, and 'now that the traits of the pure article have been so long unknown, 'a trade organ says :—'If on occasions really genuine turpentine 'is offered for sale, buyers fight shy of it on the idea that such an 'unwonted material *must be bad.*"—(*Indian Engineering*).

This was what would seem to have happened to the turpentine manufactured in Debra Dun. Samples sent to Calcutta were examined and very doubtfully reported on ; and it seemed as if the Merchants fought shy of it as it was too pure. Their doing so did not matter much, as the demand in Upper India so far exceeds considerably the supply that can be obtained until better communications have been established with the Upper Tons forests.

Management of 'Minor Forests' in Madras.

The following extract is from the Report of an interview which a representative of 'Commerce' had with Mr. C. Krishna Menon, the Lecturer on Agriculture at the Sydapet College, Madras, who was in England on leave during the winter.

We have always been of opinion that 'village forests,' such as the Forest Acts provide for, might be more largely established than they are, and that perhaps by degrees the responsibility of management might teach the villager the necessity for husbanding forest resources better than many orders of Government:—

"Have you anything further to propose?"

"Yes, certain proposals dealing with the forests. Not that 'I want to say a single word against the Forest Department. It 'has done an immense amount of good. But there are certain points 'in which a revival of the old communal spirit might enable the 'villagers to look after their own requirements in the matter of 'fuel and fodder reserves.''

"I shall be glad, Mr. Menon, of some particulars."

"You shall have them with pleasure. We are only concern-'ed with minor forests and pasture lands. Minor forests are 'scarcely forests in the true sense, but they grow plenty of inferior 'trees, useful for fuel and for ordinary farm tools. A great dan-'ger to Indian agriculture lies in the scarcity of fuel. Cattle dung 'is used for fuel, and thus there is a lack of manure. Now I think

'the Board, whose formation I have been advocating, should have 'charge of such forests, and look after the interests of the people 'of the villages, and see that they have a proper supply of wood 'fuel. As regards the pasture lands, the Government of India 'have already declared that 'it will generally be possible to lease 'or otherwise manage the unoccupied lands of villages through the 'agency of the community.' Nothing more can be wanted than 'that the responsible officers shall carry out the instructions of the 'Government."

English Timber Supply.

Mr. A. D. Webster's letter, dated February 27th, drawing attention to the present low prices of forest produce has not yet been answered in *The Daily Chronicle*, but Mr. Webster has repeated his advice to landowners not to plant, in a recent number of the *Timber Trades Journal*, and it therefore seems necessary that something should be said on the other side of the question. The fall in prices is felt everywhere, and is chiefly due to the cheapening of transport, notably by sea, and the consequent opening out of remote forests to the timber trade, of which the British Isles are the centre, and regulate prices throughout the world.

All countries, except perhaps Germany and Scandinavia, either produce insufficient timber for their own requirements, in spite of their excellent system of forestry, as in France, or as in North America and Russia are wasting their forest resources on a gigantic scale and without any care for the future. Our annual imports of timber of about 6,000,000 loads, of 50 cubic feet each, the produce of as many acres, is steadily increasing, and imports of timber are increasing in France and other countries insufficiently stocked with forests.

In spite, therefore, of the present fall in prices, which is only due to temporary causes, we have to deal with an increasing consumption and decreasing production of an article which it takes scores of years to mature. Anyone planting at present cannot hope for any return, except from thinnings and underwood, for the next thirty to sixty years, and present prices of timber have nothing to do with those which will then rule the market. Unless former generations had planted or protected their forests, where would our present supply of timber be, and what will our descendants do unless we plant? The prices of timber during 1894, as given by the *Timber Trades Journal*, were as follows :—

	Per cubic foot.		Per cubic foot.
Oak ...	6d. to 2s. 6d.	Beech ...	4d. to 1s. 4d.
Ash ...	8d. to 2s. 6d.	Elm ...	6d. to 2s. 0d.
Sycamore	6d. to 3s. 0d.	Larch ...	6d. to 1s. 6d.
Spanish Chestnut ...	8d. to 1s. 6d.	Scotch Pine	1½d. to 0s. 9d.

The great variations in the price of timber at different places throughout Great Britain are due to differences in quality and in local demand, and in many cases to the high inland railway rates, whilst foreign timber, sent at reduced rates, direct from a port to the place of consumption is unduly favoured. Mature oak, ash, sycamore, Spanish chestnut, and larch are everywhere in demand locally, as in the Chiltern Hills, and the same applies to elm. The low prices quoted for Scotch pine are due to the market being temporarily glutted by the millions of trees which have been blown down in Scotland This wholesale destruction of the Highland forests is admitted by the Scotch Arboricultural Society to be due to a disregard of sylvicultural rules in planting and felling, and their annual excursion this year is to Germany, where the Scotch foresters hope to study the proper system of protecting their forests against gales.

Another reason for bad prices of home as compared with foreign timber is that much of it is grown for ornament, game-preserves, shelter, and not for economic purposes; being of inferior quality, it cannot possibly compete with the fine picked timber which is sent us from abroad. Until our woods are rationally managed, they cannot be remunerative, one of our chief defects being the absence of a steady annual supply from each forest which would enable merchants to make proper arrangements for conversion and transport.

To show that, in spite of low timber prices, which are, however, better in the British Isles than in any other country, forests can still be made to pay their way, I give the following average results of the last ten years for three Crown forests, the figures having been kindly supplied to me by Mr. E Stafford-Howard, the Commissioner of Woods and Forests:—

	Average Annual Receipts.	Average Annual Expenses.	Net Revenue.	
			Total.	Per Acre.
ESHER WOOD Oak standards mostly self-sown over ash, hazel (area in acres, 849) and other coppice.	£	£	£	£. s. d.
	881	438	443	0 10 5
HAZLEBOROUGH WOOD— Oak standards probably planted 1830-5 (area in acres, 489). Underwood of no value.	789	253	536	1 1 11
SALCEY WOOD— Oak standards probably planted 1832-46 (area in acres, 1,260). Underwood, ash, and hazel of little value.	1,730	678	1,052	0 16 8

All conceivable charges, such as local rates, receivers' commission, erection of cottages, &c., have been included in the expenses, and the oak-bark in the Esher wood, as well as the lop and top, is given to the purchaser of the standards, so that the present low value of oak-bark has not affected receipts materially.

Some of the best beech-woods in the Chiltern Hills yield a net profit per acre of £1 2s. 6d., after paying rates, taxes, and all other expenses. It is everywhere admitted that larch plantations pay well, provided they escape disease; so do those of Spanish chestnut and ash. The owner of the Welsh fifty-six-year-old larch plantations, which were recently sold at £90 an acre, has replanted his land.

The above facts tend to show that neither the State nor private landowners who own waste lands are justified in leaving them unplanted, provided the work is intelligently done. Future generations will certainly require timber for railway sleepers and carriages, for house, ship, and boat building; for barrels, casks, and packing-cases; for machinery-frames, carts, and furniture; as well as underwood for hurdles, hop-poles, clothes and orchard props, broom, bean and pea sticks, &c.—I am, &c.,

W. R. FISHER.—*In 'Daily Chronicle.'*

The Preservation of Timber.

There is about to be introduced into this country a process of preserving timber which has been for some years in operation in the United States, the details of which have been worked out by Colonel Haskin. Ordinarily the treatment of timber, to obviate decay, consists in the application, after being dried, of some antiseptic—chloride of zinc, sulphate of copper, bichloride of mercury, and, much more extensively, *creosote*. But Colonel Haskin believes that the timber in its green state has in itself the properties essential to preservation, and the process associated with his name is designed to utilise those properties. The wood in its green state is placed in a large air-tight vessel, and is there subjected to an air pressure, varying according to the timber, from 150 lb. to 200 lb. to the square inch; and this air is dried first, and heated by passing through pipes over a stove, the ultimate temperature being from 200 deg. to 450 deg. Fahr., according to the nature of the wood. The effect is said to be a chemical change in those compounds—albuminous, glutinous, resinous, or oleaginous—which constitute the sap of the tree, so that the fluid matter becomes insoluble, and coagulated in the pores, preventing decomposition. This result is attained in about eight hours' treatment for, say, a mahogany log 12 in. thick, the time varying with

the thickness. The process has thus the merit at least of great rapidity, but time alone is the arbiter of its preserving qualities. Several specimens are being exhibited at the company's office, 2 Dean's-yard, Westminister, and they seem homogeneous, while some polished slabs, particularly of pitch pine, gain in the richness of grain, due to the fact that the resinous compounds are present in all their natural richness, although, of course, prevented from exuding by reason of the process to which they are subjected, and which is not unlike roasting, or rather boiling an egg. *America Cup in 'Engineering.'*

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Notes on Changa Manga.

The extensive sissoo plantation of Changa Manga must be known by reputation, at least, to many readers of the *Forester*, though the subject has not often been mentioned in the pages of this journal; and, it is believed, that a few notes, taken from observations made during the last few years and brought up to date, may prove of general interest.

Changa Manga is situated in the Chunian tahsil of the Lahore district, 44 miles by rail south-west of the capital of the Punjab. The scarcity of fuel led to the formation of the plantation on the borders of the Bari Doab Canal, and by about 1877 the whole had been planted up chiefly with sissoo. At the present day, the plantation contains nearly 10,000 acres, of which 8,400 acres are wooded.

For many years the irrigation was unsatisfactory, partly owing to scarcity of water, which could only be granted when not required by the zemindars, but also partly owing to the irrigation channels not having been laid out in the most advantageous manner, so that it is highly probable that some compartments received water irregularly. This has, however, now been remedied, and it is possible to irrigate the whole plantation once, and half of it a second time every year. The appearance of the crop in 1895 proves that the irrigation is much more complete than it was—there is a much healthier look about it.

Coppicing began in 1880-81, and it has been continued ever since; and in 1895-96 the last remains of the seedling forest will be coppiced, so that in 1896-97, the second rotation will commence, and the compartment first coppiced will be taken in hand again. The crop in these compartments will then be about 15 years old on an average, and it will be exceedingly interesting to ascertain the outturn per acre, and the mean annual increment, and compare it with the figures yielded by the seedling forest. My own impression is that neither the outturn per acre nor the increment will be as high as those given by the original plantation.

Mulberry has in many compartments come in, and completely suppressed and killed out the sissoo stool shoots, and the future crop in Changa Manga, after the second rotation has passed, will probably be pure mulberry. It remains to be seen whether at the age of 15 or 16 years this species will yield as much as sissoo, but from its manner of growth and general appearance this seems extremely doubtful. Though at first in the coppice mulberry grows faster than sissoo, yet the latter species catches it up at the age of 16 years, and has a better bole.

An attempt has been made to indicate the height growth of the two trees from the mean of four years' measurements, but owing to differences in the soil of various compartments, and probably to defective irrigation, the result is not as satisfactory as it might be. Still it is better than nothing. [See diagram.]

The statement on the next page exhibits the result of the fellings made since 1882-83, after which year the records have been carefully kept, and may be regarded as reliable and accurate as any such statistics can be in the present state of Indian forestry. The outturn in solid cubic feet has been calculated, according to the reducing factors adopted in the working plan, and the table shows that at an age of 16 years the mean annual increment per acre is at a maximum. The outturn is here taken as the saleable production, only leaving out of account unsaleable brushwood which is burnt on the area, and whatever is lost in cutting. This agrees with what was written in the working plan (para. 64) as far as the age is concerned; but the mean annual increment is there estimated at 100 solid cubic feet, whereas the figures before us show only 83 c.-ft. It is, however, admitted in the "Revised Proposals of 1889" that the yield of the older crops had been over-estimated, and it was believed that the yield of the younger crops had been under-estimated, and that a lower rotation would be better.

As an example of the best individual compartments the following may be taken :—

C.-pt.	Area.	Age.	Fellings	Thinnings	Standards.	Total.	Per acre.	Per ann.
75	150·4	18·0	167,561	78,433	14,245	260.239	1,730	96
76	63·6	16·5	65,949	28,513	9,824	104,286	1.640	99

So at an age of 16½ years the best compartment shows a mean annual increment very nearly equal to that estimated in the working plan. This is a remarkable result, and certainly indicates the great care with which the working plan was drawn up. It is quite probable that a well-stocked compartment of sissoo on good soil and regularly irrigated would in Changa Manga yield 100 solid cubic feet per acre per annum at the age of 16 years, *when raised from seed*. But it is doubtful whether either sissoo or mulberry *coppice* will yield as much—this must be left for the future to decide.

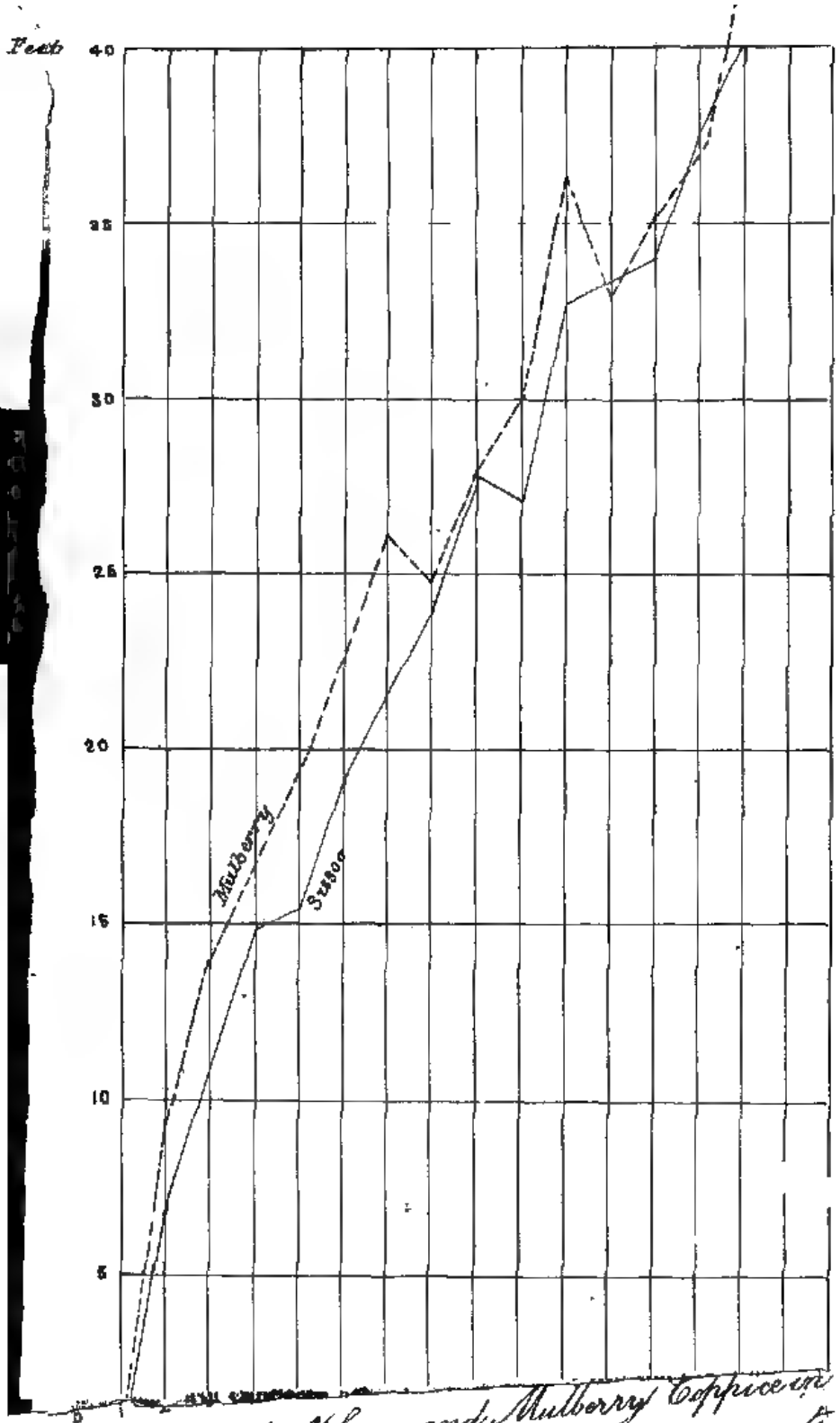
The comparative height and girth of coppice shoots of sissoo and mulberry at various ages are given in the following table :—

Age	Sissoo.		Mulberry.		Remarks.
years.	Height.	Girth.	Height.	Girth.	
	feet.	inches.	feet.	inches.	
1	7·2	2·0	8·7	3·1	
2	10·8	3·4	13·7	3·8	
3	14·7	5·0	16·6	6·0	
4	15·5	6·0	19·2	8·9	
5	19·3	8·7	22·6	11·7	
6	21·5	9·7	26 2	12·2	
7	23·9	12 7	24·8	12·7	
8	27·7	16·4	29·9	16·6	
9	27 0	16·5	*	*	* Sufficient measurements of this age not available.
10	32·8	21·5	36·1	26·	
11	33·1	19·6	32·8	22·1	
12	33·7	22·1	35·1	29·3	
13	37·5	26·9	37·2	33·4	
14	39·8	26·4	42·2	32·	
15	37 4	24·	37·7	30·	Only 10 acres of this age.

It need not be a matter of surprise that discrepancies should appear in a table such as the above. Certain compartments which have suffered from insufficient irrigation, or a bad subsoil, affect the figures ; they are the best that can be given under the circumstances, and they are taken from a series of measurements made by the Forest School Students during the years 1892, 1893, 1894 and 1895.

FELLINGS MADE IN CHANGA MANGA FROM 1883-84 TO 1893-94

Year.	Compartments felled.	Area acres.	Age.	Outturn in solid cubic feet.				Outturn per acre.	Mean annual increment.	Remarks.
				Principal fellings.	Previous thinnings.	Standards.	Total.			
1883-84	39, 43, 44	148·4	12·67	114,558	15,177	19,600	149,335	1,006	79	
1884-85	19, 20, 23, 24, 27, 28, 32 34, 35, 37, 40, 54, 55	901·8	13·9	570,035	256,368	129,650	956,053	1,060	76	
1885-86	30, 31, 47, 48, 51, 52	517·4	15·0	336,182	145,396	68,800	550,378	1,064	71	
1886-87	pt. of 5, 13 to 17, 49, 50 53, 56	754·7	15·14	505,356	205,218	156,710	867,284	1,149	76	
1887-88	18, 21, 22, 41, 42, 45 46	368·6	16·0	291,709	112,382	87,270	491,361	1,333	83	
1888-89	25, 26, 29, 33, 36, 38 73, (b), 75, 76	601·0	16·83	548,106	193,476	56,728	798,310	1,328	79	
1889-90	71, 72, 73, (a), 74	414·0	17·5	363,260	158,687	47,401	569,348	1,375	78	
1890-91	58, 59, 62, 69, 70	403·8	17·9	414,917	73,554	49,166	542,737	1,344	75	
1891-92	57, 60, 61, 63, 64, 65	852·0	18·16	638,779	145,807	100,723	885,309	1,358	75	(1) Area includes badly stocked portions of Manjoki Jhand extension.
1892-93	77 to 94 (1)	565·5	18·0	439,098	67,787	66,689	573,574	1,014	56	
1893-94	95 to 98 (2)	282·3	17·0	243,288	40,535	27,336	311,159	1,100	65	(2) Soil in these compartments inferior.



Height growth of Sissoo and Mulberry Coppice on Changa Manga. Mean of 4 years measurements.

Tapioca cultivation in Travancore.

Introduced by the Portuguese in their early settlement at Goa, about the commencement of the sixteenth century, the Bitter Cassava or Manioc, familiarly known as the Tapioca, has been cultivated on the west coast ever since. But nowhere, perhaps, on that undulating, palm-fringed sea-board has it thriven so well as within the flowery dominions of His Highness the Maharaja of Travancore, where the soil and climate are variable and equable enough to suit it as well as many another tropical South American species like itself. With an abundant rainfall, a gorgeous and invigorating sunshine and a perennial dew, evergreen species, indigenous and introduced, many and varied, live and thrive. Under these conditions, that a hardy Euphorbia like the Tapioca, indifferent to soil and unmindful of all but extremes of climate, should, when brought under even the rude cultivation of the Malayalee peasantry, cover extensive areas of both hill and dale, must pass without exception.

Towards the middle of October or the beginning of November when the north-east monsoon is usually at its height, suitable areas, often several acres in extent, are selected for cultivation. The soil being then soft, moist and easily worked, is either deeply hoed or ploughed over, and the surface laid out in mounds or platforms each from two to three feet square, and about a foot high. Sometimes circular or rectangular patches, a yard in diameter, are prepared. The platforms and patches are, in some localities, dressed with ashes, leaves or cattle-droppings, but they are, especially in free, loamy soils, usually let alone. A sufficient number of stems for stocking the area are selected from the previous year's growth, which is either still standing or but recently removed. Each stem is cut up into several little bits varying from six to eight inches in length, care being taken to, in so doing, secure for the plantation only the lower and more mature portions of the stems. Should there be too much rain, the cuttings are kept under cover until a favourable break in the weather occurs; for, if put out in watergorged soil, they are liable to decay. It is also for this reason that, as far as possible, the Malayalee selects a well-drained locality—usually a hill-side. But if it be only showery weather and the area well-drained, the cuttings are put into the beds directly they are prepared. A bed or patch is considered fully stocked if it hold two or three cuttings which are put down each at a slant of about 60 degrees and, buried in the soil for nearly two-thirds of their length. Varying from ten days to a fortnight of their being put out, the cuttings strike root, and the young shoots come up vigorously in light-green tufts of pretty palmate leaves. It is interesting to note that the earliest leaves are usually small, and either three or five-lobed, but these are soon supplanted by larger and seven-lobed ones arranged on the

stems in a close alternate phyllotaxis. While the leaves are emerging in all directions over the gradually elongating wand-like stem, the numerous roots, white and thread-like, radiate from its base into the cultivated area around. In a month or two after the cuttings are put out, the lateral development of their roots begins, and, in another eight or ten months they will, in average soil and under ordinary cultivations, have sufficient y developed to be dug up for use. But, as a rule, the roots are allowed to remain in the soil for two more months, in order that the cultivator may, by falling in with the ensuing wet season, secure for the future crop the best results. The rotation of the crops is thus maintained in an uninterrupted annual cycle fixed by the monsoon rains. But should the rains be late and the market favourable, the Tapioca is dug up as soon as it matures, and, as this would be towards the end of the hot season, the new plantation is started at once, but copiously watered once every three or four days until the rains are fairly on It is said that, so far from interfering with the normal growth and development of the Tapioca, this hot-weather cultivation yields good enough results to quite repay the extra labour it entails. Indeed, the scarcity of water towards the close of the hot-weather alone prevents the practice being more largely adopted. Again, a peculiar race of the Tapioca, which is cultivated here, yields two crops in the year; the first of these is, at the end of six months, harvested in March—one of the hottest months of the year. As the stems cannot be kept for any length of time without drying, the plantation of the ensuing season is started forthwith, the cuttings being watered until the April showers begin, after which the young plants are left to themselves. The hot weather, though short, is sometimes, and especially of late, very oppressive; but the plants rarely fail except in extremely stony or sandy soils, and it is the experience of the Malayalee that the roots produced by these hot-weather plants are more wholesome and delicious than those yielded by the previous cool-weather ones

The yield of Tapioca varies with the soil, the amount of care bestowed on its cultivation, the nature and quantity of the manure used, the rainfall and the particular race or variety cultivated. Although it grows on almost any soil—from stony laterite through gravel to sand and even clay,—it thrives best on a well-drained soft, sandy loam with an admixture of humus. Stony soil interferes with both quantity and kind, gravel tends to contort the roots often to such a degree as to unfavourably influence their appearance and market value while clayey soils, always cold, prevent their developing to normal dimensions. Again, the larger the quantity of manure used, the better the yield and the more farinaceous the roots. Ashes or ashes and leaves give the best results, while cow-dung or other cattle-droppings frequently only injuriously affect the quality, though they improve the quantity, of the roots of the more nauseous varieties.

A well-grown healthy root is generally about 2 ft. long, 3 inches in diameter and between 6 and 8 pounds in weight. It is generally a little thicker at the attached end, and tapers gradually to a more or less fine point at the free-end. The usual colour of the thin outer skin of the root is a pale brown, a stout, tough white sheath of inner skin closely investing the delicate substance of the root itself. On breaking across it, this brittle substance, turgescent with milky farina, is seen to intimately adhere to and lie around a compact vein of dense, fibrous tissue that runs through the centre of the root for its entire length. This vein is probably the original thread-like fibre around which the farinaceous substance is subsequently developed. The root contains the greatest quantity of farinaceous material in from ten to fifteen months after the cuttings are put out, but if allowed to remain in the soil after that time, it soon grows woody, and ere long deteriorates into a soft, spongy mass, the tough fibrous core at the centre being replaced by a narrow canal containing a pulpy, decaying fluid of grey cellular matter. It is also interesting that, under ordinary conditions, the Tapioca root seldom bifurcates or divides in any way, and that even root fibres are few and far between; so that, absorption of the requisite substances from the soil takes place chiefly through the epithelium of the root itself.

The cultivation of the Tapioca by the hill-men of Travancore is even ruder than that pursued by their more enlightened brethren of the low-country. Every year, towards the close of the hot season, extensive patches of forest are cut down and burnt; and, as soon as the monsoon rains have descended different kinds of paddy, ragi, maize and Indian corn, cumlies, dal and other seeds and cereals are sown broadcast and hoed into the soil. Tapioca sticks, too, are put down here and there over the area, and what with the wood-ashes, the humic accumulations of years and the grateful showers, a motley assemblage of plants soon covers the clearing. Each grain is harvested as it matures and, in due season, the Tapioca, too, is pulled up. Directly they are taken up the roots are washed, pealed, and cut up into little irregular pieces which are strewn over mats made of the large Ésta reed (Beesha Travancorica) or, what is more usual, upon the bare out-crops of sheet-rock so common on the higher hills; and the sun soon hardens them into the flinty, white chips familiarly known as Kani marachini ("the Hill-man's woody potato"). As a rule, the hill-men cultivate just enough grain and Tapioca to meet their requirements for six months of the year, precariously subsisting for the remaining months on wild yams, bulbs and roots. The more forward among them, however, who shrink less from their cultured congeners of the low-country frequently barter some of their produce in exchange for salt, knives, cloths and other necessaries and luxuries of life. When this is done, it is that their excellent Tapioca finds its way to us.

This hill-tapioca is much prized by the poorer inhabitants of the outlying towns and villages, because it is believed that the varieties cultivated by the hill-men are generally harmless and that, for the rest, any nauseous or bitter principle that may remain is efficiently removed by the thorough drying which the roots undergo.

The various processes adopted for removing the poisonous principle of the root, which is now admitted to be some form of Hydrocyanic acid, are interesting. Certain varieties which under the name of the Avians or Boilables are considered harmless, are eaten plain, or made into curry after a single boiling. They are also frequently roasted and eaten with fish curry. The more poisonous kinds are boiled several times, the water being strained off after each boiling. When this process is adopted, the root, after each boiling, is tasted: should it taste sweet, it is boiled again, and this is repeated until the peculiar sweetish flavour disappears. An extremely nauseous variety known as the "white Tapioca" has to be boiled at least seven times before it becomes fit for food! Again, the roots of certain other varieties are cut up transversely into thin circular or oval slices, which are dried and then boiled. Frequently, the slices are boiled several times and then dried. But when so constantly boiled, the Tapioca, on coming to be cooked, is tough and insipid to the taste and certainly less nourishing. Should the bitter kinds be insufficiently boiled before they are used, violent vomitting, attended with severe pain over the region of the throat and stomach ensues, the victim grows drowsy and general prostration and collapse soon follow. The same symptoms are produced by drinking the water in which the roots are boiled. When eaten with sugar, jaggery or molasses, the nausea is very pronounced, and the comatose condition sets in sooner; on the other hand, cocoanut, cocoanut-oil, curds and tamarind juice act as vigorous and grateful antidotes, while, a solution of assafœtida in water is given to goats and other cattle that are frequently poisoned by eating the leaves of the more nauseous varieties.

Under the local names of Marachini (woody potato) or Kappa Kelangu (ship potato), about seventeen commonly-recognized varieties of the Tapioca are cultivated in Travancore. But these are evidently only races descended from a few distinct varieties and differentiated through long and peculiar forms of cultivation, not to speak of the powerful influences of soil and climate. These races, proportionate to the bitter priniciple they contain, may be conveniently brought under one or other of two heads—the Avians or Boilables and the Maravans or Dark races. For purposes of study, the following classification has, accordingly, been found useful.—

I—The Avians or Easily boilable kinds, characterized by little bitter principle,

(a) *Pacha avian*, (green boilable)—Leaf-stalks pink along their upper surfaces, but green beneath, and at their origin with the blade and insertion at the stem; stems 2 inches in diameter, light green, average height 12 feet; flowers rare; roots pale red, large; average weight 15 lbs. each, mature after one year.

(b) *Cheenee Avian*, (Potato boilable).—Leaf-stalks and stems pale yellow; stems delicate, usual height 5 feet; flowers after one year; roots white and, like the *Ipomea Batatas* (sweet potato), mature in six months after the cuttings are put out, they start in delicate strands from the base of the stem, and develope a few inches beyond it; average weight 10 lbs each. This is also called Vellary avian (white boilable).

(c) *Chovalay Avian*, (Red boilable)—Leaf-stalks and stems light-red; flowers common; roots small, light red, firmly attached to the stems, mature in one year, average weight 10 lbs each.

(d) *Curry avian*, (the curry boilable).—Leaf-stalks and stems pale pink; delicate plants, usual height 4 feet; flowers common; roots light-red, large, average weight 12 lbs. each; mature after one year, mealy and wholesome.

(e) *Chànà Avian* (the cow-dung boilable)—So called from the manure usually used in its cultivation. Leaf-stalks pale but red at extremities; Stems red, usual height 8 feet, roots few, substance of root arranged in two zones—the outer firm and farinaceous, the inner soft, pulpy and unfit for food; average weight 8 lbs. each.

(f) *Chenkomban* (the red-stemmed) a variety resembling the *Cheenee avian*, but with the leaf-stalks and stems a bright scarlet.

(g) *Neduvengauden* (the Neduvengaud Tapioca)—So called from the district of that name in Travancore where it was first cultivated:—Small race, leaf-stalks and stems pale pink, roots small but numerous; average weight 4 lbs. each.

II.—*The Maravans or Dark races*, like the particular dark-skinned class of thieves of that name in the Tinnevelly District These are all more or less nauseous:—

(a) *Olley Karim Maravan* (the dark Maravan)—Leaf-stalks deep red; stems dark green with purple streaks below the attachment of the leaf stalks on the stem; plants delicate; flowers rare; roots mature in one year, few, deep-brown, slightly nauseous; they are very lightly attached to the stem; average weight 10 lbs. each.

(b) *Neduvàli-Kian Karim Maravan* (a race whose roots take as firm possession of soil as the tenacious claws of the Neduvàli or Iguana lizard).—A much-branched race with stem and leaf-stalks like Olley Karim Maravan; flowers

common ; roots few, woody and have to be boiled twice before the bitter principle is removed.

(*c*) *Ana Maravan* (the giant Maravan)—Leaf-stalks and stems like those of (*a*) in colour ; but the stems are tall, thick and strong, being usually about 20 feet high ; flowers rare ; roots very large, average weight from 20 to 25 lbs each, and take 15 months to mature ; very nauseous, requiring to be boiled three times.

(*d*) *Kathelay marachini* (Kath-elay, *i.e.* bitter leaved)—Leaf-stalks like those of (*a*) ; stems pale yellow streaked with red ; flowers common ; roots small but numerous. The race was at one time largely cultivated, but it is now rare, nauseous like (*c*).

(*e*) *Koota Maravan* (the Dwarf Maravan)—dwarfed much-branched race, usually 2 or 2½ feet high ; leaf-stalks and stems like those of Kath-elay Marachini ; roots lightly attached to the stem ; very nauseous.

(*f*) *Ellavum Kappa* (areca-like potato)—Tall race like the Ana Maravan ; stems and leaf-stalks dark red ; roots thin and numerous—often 25 to the stem ; flowers rare ; very nauseous

(*g*) *Avanakkum Kappa* (the castor-oil-plant-like potato)—Dwarfed, much-branched race, 4 feet high ; leaf-stalks red ; stems greenish-ash coloured ; roots few—at most four, small; slightly nauseous.

(*h*) *Vellay Marachini* (the white Tapioca)—Leaf-stalks and stems pale green, tall, delicate, much-branched, usual height 25 feet ; flowers rare ; roots brown, lightly attached to the stems ; most poisonous, the bitter principle being eliminated only after at least seven successive boilings ; race growing extinct, being sometimes cultivated in North Travancore.

(*i*) *Olaven*—Delicate rare; stems small, 3 feet high, branched; flowers common ; roots small, few, slightly nauseous.

(*j*) *Kili vakay* (the Parrot green Tapioca) –Stems and leaf-stalks bright green ; leaves few and far apart ; usual height 10 feet ; flowers common ; roots large, few, average weight 12 lbs ; slightly nauseous.

Of these races, the most nauseous, it will be seen, are the Vellay marachini and the Kath-elay, both which, however, are the oldest cultivated, and are now becoming rare ; so that, long cultivation has, in their case, done comparatively little towards improving the quality of their roots. When left to themselves, and especially under cover, all these races grow into tall and lanky plants which in time assume the nature of climbers, many of which are often 30 feet high.

With regard to the position the Tapioca *industry occupies in* Travancore, it may be said to compare favourably with many another similar industry in that country. Much of it is exported, *especially of late*, and, *judging from the increasingly extensive* areas under it, the importance of Tapioca-cultivation as a profitable industrial pursuit is coming to be realized every day. The Tapioca has long since established itself as an important and excellent article of diet with the Malayálee, and the recent steady rise in price of rice bids fair to make it one of the first staple-food-stuffs for him, if it is not that already.

TRIVANDRUM,
23*rd June*, 1895.

A. M. SAWYER.

The "Ceylon Forester."

We have, by the courtesy of the Editor, Mr. H. P. C. Armitage, Forester at Trincomalee, received the first three parts of this new contemporary, which we cordially welcome, and to which we wish every success. It is a small Magazine of about 16 pages monthly, the subscription is Rs. 5 yearly, and the cover shows an old banyan tree with many root props, and a palmyra growing out of its crown.

The first number, that for January, 1895, has an Introduction, and then a short history of the Ceylon Forest Department. There are useful botanical notes on various trees and plants of the Ceylon forests, and the first part of a paper on elephant catching in the Northern Provinces. In the February number is described the saw-mill and Depôt at Batticalva; the botanical notes are continued, and there is a further instalment of the paper on elephant catching. The March number continues these papers still further, and has an interesting account of the Satinwood tree by Mr. Broun, the Conservator. We commend this new periodical to the attention of Indian forest officers, and especially to those in South India.

Forestry in the Simla District.

We have received a foolscap volume covering 26 pages of printed matter and bearing the somewhat high-sounding title of a "Manual of Forestry." The title page goes on to tell us that it was prepared for use in the Simla District, and may be purchased for 8 annas. On further examination, the Manual appears to be a collection of notes by a Punjab Forest Officer drawn up some years ago, and now published under the sponsorship of Mr. W. Colustream, C.S., (Retired), late Superintendent of the Simla Hill States. It is not said whether the Punjab Government consulted their Conservator before passing the book through the Government Press, or whether A. L. M., really approved of its *publication*. We cannot help thinking that he did not, a perusal of the pages disclose many inaccuracies, contradictions and other defects, which lead us to regret that they should ever have appeared in print at all, without careful revision by the compiler, or being edited by some professional Forester of experience.

The first essentials of a book destined to be useful to native chiefs in the management of their forests would seem to be soundness, accuracy, clearness and simplicity; and one would suppose that the scope of its utility would have been considerably enlarged had it been printed in the vernacular instead of in English. In all these respects, the Manual leaves much to be desired, and the author himself will doubtless be one of the first, when he reads his notes in print, to allow this. We hope that the remarks we propose to make may not seem to be more harsh than necessary, but rather than allow such a work to go forth with the impression that it embodies the accepted principles of the Department and is the outcome of the widest experience, we consider it our duty to risk such charge, and to boldly express our opinion. If they should induce those responsible for the Manual in its present shape, to at once proceed to its revision, and the publication of a vernacular edition, we shall have done good service.

Such curious expressions as '*Cultivations*' and '*Standing Capitals*' at once attract notice, and make us wonder whether the latter has any connection with 'standing type' with which we are so familiar.

In para 6 we are told that "it is better that fallen leaves 'should be removed than that trees should be lopped." We cannot agree with this as a general maxim. The lopping of inferior species like the 'Ban' and 'Moru" oaks of the Himalaya, which are little, if at all required for timber or fuel, is a necessity for the agriculture of the country, or at any rate, is a practice which has to be allowed and provided for, and we think it might often be better for such trees to be judiciously lopped under proper rules, such as are usually in force, than that the cover of dead leaves, which is so valuable to the soil, should be systematically taken away.

We are told in para 8 that "if a tree is sawn up carefully, 'planks or scantlings equal to one-quarter to one-third of the 'total amount of wood it contains are usually obtained." Surely the author must remember the beautifully cylindrical stems of the silver firs in the Vosges, the loss from conversion of which on the contents cubed by ¼ girth squared, is as low as 20 per cent., and he ought to know that 50 per cent. covers the loss on rough and ill-shapen logs, such as are often found in oak, teak and other trees with irregular section. This brings us to the startling conclusions in paragraphs 12—14, *viz.*, that to furnish good planks and scantlings for Simla, a tree should not be less than four-and-a-half or five feet in girth, while if sleepers and scantlings are wanted for the plains, trees should never be cut before they are six feet in girth, and it is better not to cut them before they are seven feet in girth. Surely the exploitable size of a tree cannot be held to vary with the destination of its scantlings, and if that size is 6 or 7 feet, as we believe it is, in the one case, it is the

same in the other, in view to the greatest yield of converted wood. Confusion seems to have crept in through a non-recognition of the percentage of loss by conversion varying with the size of the tree. In the case of a 4 ft. 6 in. tree the loss may be as high as 60 per cent., while with a 6 ft. tree it should invariably be less than 50 per cent. The author might well have refreshed his memory by a reference to Nanquettte's *Debit des bois*, or other work on utilisation.

The qualities of kail (*P. excelsa*) wood as described in para 9 are difficult to grasp, and a Punjab Officer should know the high esteem in which this wood is held in the Murree and Hazara hills. For inside fittings, we should think that 'kail' wood is better than 'kelu' (deodar) as taking a better polish, having no strong smell, and not being liable to get dirty so quickly.

It is only *usually* better to sell by the tree, than by the outturn of converted timber. We know of no exception to this rule, which obviously forces the purchaser to utilize the tree to the utmost and saw it up to the best advantage. It would be interesting to know where the khair (*Acacia Catechu*) forests are, which supply Simla with firewood. We only know of this tree at about 3,000 feet, and doubt its existence in quantity within reach of Simla.

The gratuitous statement that it is best to cut the oak, ban mohru and kharsu, for firewood when they are twenty-five to fifty or sixty years old is calculated to mislead. Our experience is that while ban and mohru may, under suitable conditions, be coppiced on a rotation of 20 years, or even less, it is more than doubtful, whether the kharsu, whose natural, region is in a rigorous climate synonymous with slow growth, and doubtful or slower reproduction, can be coppiced at all with success, or treated otherwise than as high forest with a prolonged rotation.

It would have been better to have told people that 20 per cent of charcoal from a kiln was a good yield, than to have said, it is possible to obtain 25 per cent, the absolute possible in closed retorts.

The paragraphs 18 and 19, describing the nourishment and growth of trees, are open to considerable objection. We should like to patent the process of forming new wood *and bark* with water and carbon dioxide; and trees fed on substances such as lime, sand, phosphorus, sulphur, &c., even in small quantities ought to feel, (if feel they could) rather like snakes fed on stones. Can it be possible that any forest officer thinks that all essential substances which trees take up, and which are returned to the soil of the forest in decaying fruits and leaves, instead of being removed as in cereal crops are lime, sand, etc? Why, we would ask, are those nitrogenous compounds to which plants owe their life and growth, overlooked?

If the author had had in mind his concluding sentence of paragraph 21, "a large tree contains a very much larger proportion of useful dark-coloured wood than a small tree," he would surely not

have advocated the cutting of 4 ft. 6 in. or even 5 ft trees in paragraph 12. Under natural and artificial reproduction, we naturally look for more detail as to local requirements and experiences than are given in this book for local use. And we are disposed to cavil at the dogmatic statement that seedlings should be planted out in the beginning of the summer rains. That is, in our opinion, about the worst time, and without laying down any hard and fast lines, we can safely say that plants require to be put out for sometime before they are subjected to heavy or continuous rain, in order that their root systems which suffer, and are curtailed in planting out, may become re-established. The winter planting of deodar succeeds well, and, indeed, so does planting in any of the dry months in the hills, provided there is sufficient moisture to keep the plants alive pending the fall of heavy rain. So far as our experience goes, "chil" will die if planted in the rainy season.

The statement that kelu, kail, cnil, etc., do not give good coppice shoots, falls short of the truth, which is that they give none at all, or only shoots resembling coppice such as are of no use or value. It is certainly new and opposed to other authorities that khair gives only poor coppice shoots.

It is at least curious that the deterioration in the growth and value of forests, should not be attributed to its chief cause, *viz.*, the over felling or clearing of forest areas. That certainly is the prime cause which prominently stands out in the forest estates of native chiefs. Many a forest has disappeared, suffered extermination, and the process is steadily going on, but the four causes enumerated in paragraph 35, are only adjuncts, subsidiary aids to the axe, which not only lops and wounds, but kills and removes outright, and is in the main answerable.

The paragraphs 36-43 dealing with the injuries to which the forests are liable, are clearly written and to the point, and we have perused them with interest, but owing to some apparent confusion of 'chal' and 'chil' in paragraph 39, are in doubt as to the writer's meaning.

When the author turns to 'natural conditions' inimical to the growth of trees, he appears to us to slip at once out of his depth, and to make but a poor attempt to swim. It is precisely where the natural conditions are least favourable, that good management is most imperative, and the Forester can be best recognised as knowing his business. It is by rearing up a dense growth, and by protecting the soil from direct sunlight and exposure that the Forester utilises, and improves the worst and most ungenerous of soils, counteracts the unsuitability of aspect, guards against windfalls, snowbreaks and the like, in short, clothes the country side with a remunerative crop. Yet A. L. M. would have the Simla Chiefs believe that "very little can be done by good management in these cases." This is most unsound doctrine.

In thinnings, where trees of equal ages are massed together, it is by no means right to say that the less vigorous trees should be

cut. On the contrary, the thinnings should remove those of the more vigorous, which are preventing their equally but not necessarily more vigorous neighbours from taking a lead, and ending their struggle to the suppression of other less vigorous stems. 'Principal fellings' are ill defined in paragraph 51. What is really meant and understood is—the fellings which remove the main crop, and are so ordered as to provide by seed or coppice for its reproduction.

It is new to us that 'high forest' is synonymous with 'seed' as descriptive of fellings in paragraph 53.

Regeneration by means of 'clear fellings' is hopelessly mixed with the well known system of 'successive fellings.' The risk of 'spoiling' the forests by these or any other system, is not inherent to that system, but is measurable only by the skill with which the system is applied.

The author of the notes falls into a by no means uncommon error of admitting thinnings in forests worked by the selection method. The forest, consisting of trees of all ages spread irregularly over the forest, the struggle for existence noticed in even aged crops is not felt in the same way, and the object of thinnings no longer exists.

The growing stock of a forest represents a part of the capital value, the interest on which is represented by the production of wood. This is called, in the book under review, the standing capital. The exploitable age of a tree required for timber is nearer 150 years than 50 or 60 as set forth in para 60.

The sketch of Working Plans and their application contained in Chapter VII is by far the best part of the notes, and this with hints as to the supervision and keeping up of records will doubtless assist owners in working their forests with system. But, from what has been said above, it will be seen that the book, which might have served a most useful and laudable purpose, has been brought out without sufficient care, and though it is not clear who is responsible for the errors, A. L. M., Mr. Coldstream, or the Punjab Government, it would be a pity to let them go uncorrected. The responsibility for the publication seems to rest with Mr. Coldstream, who has rashly assumed in his prefatory remarks, that the note contains "so much of a general nature in the way of a short and 'popular statement of the principles and practice of forest con-'servancy, that they may probably prove extensively useful, out-'side the Simla District."

Marram Grass in Australia

Vernacular Names.—"Marram" appears to be the spelling, and to represent the pronunciation of the name of this grass as generally accepted in the colonies, and I have no wish to disturb it. This name follows the spelling given by Sir J E. Smith in his *English Flora* (1824). In Hooker's *Student's Flora of the British Islands*, the spelling is given as "Marrem," while in that magnificent work, *Sowerby's English Botany*, it is called "Murram"; and it is there stated that, according to Mr. Prior, the name is derived from the Gaelic *Muram*, or the Danish *Marhalm*, sea haulm, or straw. Other names are mat-grass, beach-grass, sea-weed, and sea-mat reed.

Botanical Name.—*Psamma arenaria.* From the Greek word for sand (*psammos*). *Arenaria*, a Latin adjective signifying "pertaining to sand."

Synonym.—*Ammophila arundinacea*, Host. (In the *Genera Plantarum* of Bentham and Hooker, *Psamma is merged in Ammophila*).

Botanical description.—Genus *Psamma* (Hooker's *Students' Flora of the British Islands*, 2nd edition, p. 462).

Spikelets, in a contracted panicle, much laterally compressed, 1-fid., with sometimes the pedicel of an upper glume.

Empty glumes, two, scarcely exceeding the flowering, rigid, subequal, long, narrow, keeled, subacute.

Flowering glume, rigid, shortly pedicelled, with an oblique callus and a short pencil of silky hairs at the base, four to five-nerved; awn minute, subterminal.

Palea, equalling the glume, rigid, two nerved.

Scales, very acuminate.

Stamens, ovary and fruit of *Calamagrostis*.

P. arenaria, R. and S.

Rootstock, widely creeping, binding the sand.

Stems, 2 to 4 feet, smooth or scabrid above.

Leaves, long, rigid, convolute, polished without, scabrid and glaucous within; *sheaths long*; ligule very long, 2-fid. torn.

Panicle, 3 to 6 inches, straight, broadest and sometimes lobed at the base; branches short.

Spikelets, erect, pedicels scabrid; empty glumes ⅓ to ½ inch, acute; keel scabrid; flowering glume and palea quite like the empty glumes in colour and texture.

Anthers, ¼ inch, linear, yellow.

Marram Grass as a Sand-binder.—Sir James Smith (*English Flora* i., 174), says (1824):—"One of the most valuable grasses for binding the sand of the sea-shore, and raising those banks, which in Norfolk, and especially in Holland, are the chief defence of the country against the encroachments of the ocean."

In Sowerby's work the following account is given of Marram Grass, and, with reference to the suggestion at its close, it is to be hoped that it will prove valuable in the saline sand-drifts of the western part of the Colony, for it has proved its value on the coast. The experiment is worth trying, and would not be expensive:—

"Its value as a natural sand-binder cannot be overrated. Many thousand acres on various parts of our coast (England), are preserved from being overwhelmed by the drifting sand by means of its agency. In the latter part of the last century a large district on the eastern side of Scotland, near the Muray Firth, was completely destroyed and rendered in a few years as desert as the Sahara by the advance of the sand from the shore, owing to the wanton destruction of the Marram that grew upon it. This grass, therefore, when found growing on sandy shores, should always be carefully preserved by proprietors of land. Acts of Parliament have been passed to protect it, which are but little attended to;

and in Holland it is said that its destruction is a penal offence. The strong underground stems, which render it so valuable as a protection against the action of the winds and waves, are capable of being made into ropes ; and people living near the coast often plait them into mats, whence one of the common names of the grass. Professor Buckman says :—'We have exhumed rhizomata of this grass several feet in length, and as these mat and weave together, in the positions indicated, they act as powerful conservators of the coast-line, and we cannot help thinking that the *Psamma* might be cultivated with advantage, with the view of keeping together some of our slippery railway embankments. To this it may be objected that it is a maritime species ; but inasmuch as we have grown it on the sandy clays of the Forest Marble, far remote from the seaside, we have no fear of its success on this account."

Dr. George Vasey quotes the following statement :—"Its long, creeping roots, extending sometimes to the extent of 40 feet, and bearing tubers the size of a pea, interlaced with death-like tenacity of grasp, and form a network beneath the sand which resists the most vehement assaults of the ocean waves."

The following account of Marram Grass (or as it is known in the United States, Beach Grass, Sea-sand Reed, Mat Grass), is taken from Charles L. Flint's *Grasses and Forage Plants* (Boston, U. S. A., 1888), and is of interest as showing how districts almost overwhelmed with moving sand may be brought into subjection through the agency of this sand-binder. It may be noted that, after the grass has done its good work, it itself should be kept in check, or otherwise it may seize upon and render useless agricultural land :—

This grass is very generally diffused on sea-coasts over the world, and is found inland on the shores of Lake Superior. It has also been cultivated by way of experiment, and with success, on the sands at Lowell, Massachusetts, and still further up on the banks of the Merrimack River. Though not cultivated for agricultural purposes, it is of great value in protecting sandy beaches. It is preserved in England and Scotland by Act of Parliament. Flowers in August.

The Town of Provincetown, once called Cape Cod, where the Pilgrims first landed, and its harbour, still called the Harbour of Cape Cod one of the best and most important in the United States, sufficient in depth to receive ships of the largest size, and in extent to anchor 3,000 vessels at once—owe their preservation to this grass. To an inhabitant of an inland country, it is difficult to conceive the extent and violence with which the sands at the extremity of Cape Cod are thrown up from the depths of the sea and left on the beach in thousands of tons by every driving storm. These sandhills, when dried by the sun, are hurled by the winds into the harbour and upon the town. A correspondent at Provincetown says :—"Beach-grass is said to have been cultivated here as early as 1812. Before that time, when the sand drifted down upon the dwelling-houses—as it did whenever the beach was

broken—to save them from burial the only resort was to wheel it off in barrows. Thus tons were removed every year from places that are now perfectly secure from the drifting of sand. Indeed, were it not for the window-glass in some of the oldest houses in these localities, you would be ready to deny this statement, but the sand has been blown with such force and so long against this glass as to make it perfectly ground.

Congress appropriated, between the years 1826 and 1839, about 28,000 dollars, which amount was expended in setting out beach-grass near the village of Provincetown, for the protection of the harbour. From the seed of this grass it is estimated that nearly as much ground has become planted with it as was covered by the National Government. *In 1854, 5,000 dollars were wisely* expended by the general Government in adding to the work; and the experience of former years was of great value to the efficiency of this latter effort. The work of fortification or protection is not yet complete. The eastern part of the harbour is much exposed to injury from the sand, which now empties itself by thousands of tons, during every north wind, into it.

"It may be proper to state," says the writer already quoted, "that this town does much in the way of 'beach-grass committee,' whose duty it is to enter any man's enclosure, summer or winter, and set out grass, if the sand is uncovered and movable. By this means we are now rid of sand-storms, which were once the terror of the place, being something like snow-storms, for drifts, which were to be removed. *Our streets are now hardened* with clay, which has been imported; and, instead of it being buried, as it would once have been in a few days, I notice that the surveyors have to resort to sprinkling it with sand in wet weather, so effectually has the culture of beachgrass answered its end.

"The mode of culture is very simple. The grass is pulled up by the hand and placed in a hole about a foot deep, and the sand pressed down upon it. These holes are dug about one foot and a half apart. The spring is the usual time for planting, though many do this work in the fall or winter. The roots of the grass, from which it soon covers the ground, are very long. I have noticed them 10 feet, and I suppose on high hills they extend down into wet sand.

Many years ago the beach which connects Truro and Provincetown was broken over, and a considerable body of it swept away. Beach-grass was immediately planted, and the beach was thus raised to sufficient height, and in some places into hills. The operation of it is like that of brush or bushes, cut and laid upon the ground, in accumulating snow in a drifting wind. The sand is collected around the grass, and, as the sand rises, the grass also rises to overtop it, and will continue to grow, no matter how high the sand-hill may rise; and this process goes on over the whole surface of the plantation, and thus many acres have been raised far above their original level.

(To be continued.)

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The Chemistry and Physiology of Foliage leaves.

*Some valuable information on the formation and translocation of starch in leaves has recently been placed on record. Up to the present it had been known that starch was formed in the day-light in the chloroplasts, and that it disappeared in the dark, that its formation depended on the presence of carbon dioxide in the atmosphere, that it is formed only where an excess of reserve material is present, and that only those rays of sun-light effect its formation, which are absorbed by the green colouring matters of the chloroplasts.

Regarding the mode of its dissolution, which was known to take place in the dark, it had been generally accepted that this was effected by means of diastase or an enzyme closely allied to it. Latterly, however, although some experiments had shown the presence of a diastatic *enzyme* in foliage leaves, a certain amount of doubt had been thrown on the truth of this by Wortmann, who questioned the methods which had been employed by other experimenters, and showed that if the diastatic power of leaves be determined by simply extracting the diastase with water, the majority of leaves would appear to be free from diastase altogether, whilst *in the case of those in* which he found diastase, it was very small in amount. He therefore came to the conclusion that dissolution of the starch in the leaf is brought about directly by the protoplasm. Referring now to the formation of starch, although it had been generally admitted to be formed during the day time, and that it disappeared more or less during the night, only one experimenter had endeavoured to determine its amount. Sachs in 1884 published the results of some experiments which he had made in this direction. He determined the gain in weight which occurred in the leaves of certain plants during the day time, and assumed that this was starch. The authors of the present communication have, however, determined the weight of both the products of assimilation during the day time and the starch, and whilst, for instance, the leaves of *Tropæolum majus* assimilated

* *Abstracts of a paper read by H. F. Brown, Esq. F.R.S., and Dr. S.H. Morris before the London Chem. Soc. *Vide* Vol. LXIII, p. 604—676.

material at the rate of 0·9 gram per square metre per hour, the amount of starch formed was not one-tenth so much, and in another experiment with *Helianthus annus*, whilst the total increased weight per square metre per hour was 0·713 grams, the increase in starch was only 0·12 grams. In relation to the question of the occurrence of diastase or of some closely allied enzyine in the leaf, the author's experiments have gone to show that there is no doubt as to its presence, and indeed that it exists in greater quantity than is requisite to dissolve and hydrolyse the starch which the leaves contain. The experiments showed further that the product of the hydrolysis of the leaf starch is *maltose*; it is also shown that when placed in the dark the amount of the diastatic enzyine increases rapidly.

Lastly, the amounts of the various sugars present in the leaves of certain plants have been determined, with a view to indicating which are first formed and which are "after" products. These experiments are as yet not completed, but so far as any conclusion may be drawn from them, they go to show that cane-sugar is the first one formed, and that after it becomes, in part at least, inverted. Further that *maltose* and dextrose are the sugars which contribute most to the respiratory requirements of the leaf cell.

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Cause of dripping of Water from Forest Trees

A Correspondent writes :—

The following remarks in regard to the dripping of water on a dry day from certain forests may interest some of the readers of the *Indian Forester* : —

Mr. C. W. A. Bruce, Divisional Officer, Upper Chindwin District, remarked as follows in his Diary, dated 1st April, 1895 : — 'I noted a curious phenomenon this morning. It was a cloudy 'morning, and no dew fell, but from all the Kanyin trees a heavy 'fall of water was dripping. It was more marked the younger 'the tree."

On enquiry it is found that other forest officers have noticed the same phenomenon. Mr. H N. Thompson makes the following observation in regard to it :—"The phenomenon mentioned by Mr. 'Bruce, has also been noticed by me in connection with the Ing 'tree, (*Pterocarpus tuberculatus*). It is most prevalent during 'the months of April and May, and in some localities, *e.g.*, the 'Ing forests on the road between Kan and Moso (Myittha 'valley), is so pronounced as often to induce one into the belief 'that a shower of rain has passed though the forest. The fluid in 'many places forming small pools under the tree.

"After some little difficulty, I found that this fluid was not 'secreted by the trees but by an insect, belonging to the family of 'Cicadidæ, sub-order *Hemiptera Homoptera*. (They are the insects 'that make that incessant noise in the jungles during the hot weather

'and rains). The fluid is squirted out by them and falls like very fine 'rain, and as these insects are very partial to Ing forest the 'phenomenon is chiefly noticed in such areas. That the fluid is 'actually squirted out by them admits of no doubt whatever, as 'the act can be noticed if the insects are caught and held in the 'hand These creatures are very difficult to see when they are on 'the trees, as *their colours are protective, and harmonize exactly* 'with the colour of the bark on which they are sitting.

"I have since noticed this fine spray of fluid in jungles other 'than Ingdaing, and I have been able in every instance to identify 'it with the secretion from the cicadas."

It would be interesting to know if this phenomenon has been noticed elsewhere.

It seems possible that the name of the "Rain Tree" given to *Pithecolobium Saman* may have been derived from rain produced in a similar manner.

A Note on *Ceroplastes Ceriferus* (White Insect Wax).

In a circular, from the Reporter on Economic Products, of last year *re* 'Insect Waxes,' information on the subject of 'White Insect Wax' was desired, and the circular stated that any notes and specimens on the subject would be very acceptable. The following few notes on the insect may be of some interest :—

Ceroplastes ceriferus is an insect belonging to the coccid family of the order Hemiptera. The existence of *C. ceriferus* in India has been known for some years, owing to the fact of its being nearly allied to the Chinese coccid *Ericerus pela*, which produces the white insect wax of commerce. The latter insect has long been cultivated in China, the white wax it produced being used in the manufacture of candles. The trade, however, has, owing to the introduction of kerosine oil, lately fallen off*. A certain amount of wax is produced by our Indian insect, but it does not appear to be suitable for candle making, the candles burning with a smoky light, and giving off a resinous odour. *C. ceriferus* is said to be scarce in India, being occasionally met with in the jungles of Central and Southern India. In Vol. II, No. 3 of the 'Indian Museum Notes,' Mr. Cotes says: —"The scarcity of the white insect 'wax in India is remarkably illustrated by the material which 'has been collected by the officers of the Forest Department. 'This material which has been forwarded to the Indian Museum, 'consists of four specimens, three of them connected with '*Phromnia marginella*" (a totally distinct insect which has a superficial resemblance to the ceriferus owing to the production in considerable quantities of a white sugary secretion, having,

*Hosie—Three years in Western China.

however, no connection with wax) "while the fourth specimen is 'the only one which represents white insect wax." This specimen was sent by Mr. W.P. Thomas, Deputy Conservator, Hoshangabad Central Provinces, and was found on *Terminalia chebula*, *T. tomentosa* and *Buchanania latifolia*. Since the above was written more information and specimens have, I believe, been received at the Museum, though, I think, I am correct in stating that its habits and life history have not yet been definitely ascertained.

On receiving the above mentioned circular in Singbhum, Chota Nagpur, a careful search for the insect was instituted. In a very short time some specimens were sent to me, but on examination they proved to be *Phromnia marginella*, by no means uncommon in this district. Soon after I found *Ceriferus* in some low scrub jungle consisting of sal, terminalias, and camellias. The conical masses of wax were confined to the Asan, though after experience showed it occurred on several other trees. Further search proved that in this division the insect was generally to be found in the scrub jungle round the villages, though it was not necessarily confined to the scrub, occurring on trees to a height of 30 feet or so. The following are the trees on which I found the coccid in Singbhum :—*Terminalia tomentosa*, *T. Arjuna*, *T. Chebula*, *Semecarpus Anacardium*, *Anogeissus latifolia*, *Ficus religiosa*, and *Mangifera indica*.

The insect appears to be by no means uncommon in this division. It is well known to the villagers who, especially the children, pick and eat the scales on account of their sweet taste.

I made an attempt to work out the life history of *C. ceriferus*, but owing to absence in camp from head-quarters, was unable to watch the insects properly. The following are a few notes that I have as yet been able to make on the appearance and life history of this coccid. In Singbhum it appears as pure white, conical shaped mounds measuring up to half inch diameter in the case of single scales (compound scales, enclosing two or three mothers, are sometimes formed by the fusion of several scales), the larger sizes being found especially on the young twigs of the pollarded Asan (here pollarded in the interests of silk culture.) The conical masses have even when quite fresh a slightly puckered surface, and this becomes more accentuated as they dry up. The wax is slightly pink in colour under the crust, the latter being pure white when fresh. The wax has a sweet taste and pleasant odour.

From information received from the villagers here, there may be found to be some element of truth in the following attempt at a life history of *C. ceriferus*. Apparently the female comes to rest on a twig about December, and we soon have the wax cones making their appearance. The conical scales are found till the beginning of the rains, *i. e.*, about the middle of June, when the young larvæ begin to make their exit from the cones and spread

over the new young leaves and twigs of the tree. These come from the eggs laid beneath her by the old female. The young larvæ are very active and spread rapidly over the tree, and presumably undergo several moults, though I have not been able to see this. I collected some of the white conical masses on Asan twigs just as the leaves were bursting in June, and placed them in a breeding cage to watch. At the same time a number of wax cones were detached from the twigs, and placed in a small glass jar. On June 30th the small larvæ from the cones on the twigs were appearing and spreading over some fresh young leaves and twigs placed in the jar.

On July 29th the small glass jar containing the separated conical scales was examined. The sides of the jar and also the cones were found to be covered with thousands of minute yellowish brown larvæ, which were emerging from the wax masses. The larvæ were wedge-shaped, narrower at the anal extremity, with no distinction between head and thorax. On examination of the conical cone of wax the mother's body was seen to have changed from its original bright, scarlet colour, and to have dried up into a hard black dome-like shell. This shell was pierced with small holes, through which presumably the young larvæ had emerged. The conical cone of wax was riddled with tunnels, the young larvæ having pierced their way through it.

I made a second attempt to bring up these, the ones that had issued on June 30th having died, owing to my absence. I had no better luck with these, and was unable to learn anything about the moulting.

This year careful search has brought to light very little of the white insect wax. The year has been unusually wet up here, and this may account for its scarcity.

If any of your readers have been able to see the further stages in the development of *Ceroplastes*, I should be interested to hear about them.

CHAIBASSA SINGBHUM.
31*st July*, 1895. } E. STEBBING.

A Note on Plant Assimilation of Nitrogen.

Although it is well known that the source of the mineral food of plants is the soil, the exact source of the nitrogen, which they require, has long been the subject of elaborate investigation and discussion. In this Note an attempt will be made to review very briefly the past history of this question and to show the position which it has assumed at the present time.

Free Nitrogen.—It will be well, in the first place, to point out the distinction between the free nitrogen of the atmosphere and the *combined* nitrogen which exists both in the atmosphere and in the soil. About four-fifths of the atmosphere consists of this element, but in this case it exists as a gas in the free state and not combined with any other substance. In this condition it is a very *inert* substance, combining with difficulty, and only under exceptional conditions, with other elementary substances.

Combined Nitrogen.—But, in quite minute quantities, there are usually present in the atmosphere two compounds of nitrogen, namely, ammonia (composed of nitrogen and hydrogen) and nitric acid (composed of nitrogen and oxygen) and in much larger quantity there are these same two compounds of nitrogen present in the soil.

In addition we find, in the soil and in large amounts, a very complex substance, named humus. This contains nitrogen in the *combined* state. Whilst the free nitrogen of the atmosphere is a very *inert* gas, these compounds of nitrogen are by no means so. They are indeed active substances which form a great variety of other and still more complex compounds. This definition refers, in the first instance, rather to the *chemical* than to the *physiological* properties of nitrogen. But just as, when in the *free* state, it is chemically inert, so, when inhaled by animals, it takes no part in the changes which proceed in the lungs, and is exhaled again without suffering change. *Combined* nitrogen, on the other hand, generally in the form of albuminoids, is a necessary food, and takes part in the nourishment of animals, these compounds at the same time undergoing change. Thus, so far as the higher animals are concerned, the terms *inert* and *active* hold good physiologically. The question whether they hold good in the case of vegetable physiology is not so simple.

Liebig, who made the subject of plant-food a special study, held that it was only necessary to add mineral food to the soil in order that plants should thrive luxuriantly, and that there was no necessity to apply nitrogenous manure, since the plant acquires it independently.

Bertelot, Ville, and others studying the same question since Liebig's time, came to the same conclusion. On the other hand, Lawes and Gilbert and Boussingault, after making most careful experiments, came to an opposite conclusion. The experiments of Lawes and Gilbert were performed in plants grown on *sterilized*

soil and protected by a glass case from the nitric acid and ammonia which are always present in small quantities in the atmosphere. The result of four years' experiments was to show conclusively that plants when grown in sterilized soil had no power to assimilate the nitrogen of the atmosphere.

Other observations made with crops in the field taught some curious lessons. It was shown conclusively that the cereal crops were benefited, particularly by an application of a nitrogenous manure, that the root crops responded more especially to that of a phosphatic manure, whilst in the case of clover, which is a plant especially rich in nitrogen, the application of extra doses of that ingredient gave but a slight increase. And generally it seemed that plants require their food to be present in particular forms. Again, it was shown by Voelcker that if a crop of clover were grown, cut and the hay removed, the surface soil was then actually richer in nitrogen than previously. The *Leguminosæ* indeed deported themselves throughout in a different manner to those of other orders. Although themselves so rich in nitrogen, they responded particularly to the application of mineral manures, the phosphates and potash. Moreover, whilst other crops could be grown consecutively for long terms of years, on the same land, *Leguminosæ* failed, after a very short time, to respond to any manure, and indeed, eventually refused to grow at all. Thus, then, without pursuing this subject farther, it was generally recognised that this order of plants possessed properties different from those of other natural orders, the members of which are included in our agricultural crops.

In 1883 Hellriegel and Wilforth commenced a series of experiments on the subject of the direct assimilation of nitrogen by plants. These were instituted from a different standpoint to those which had been conducted by previous workers Plants, both leguminous and non-leguminous, were grown in *sterilized* soil in separate pots. To some of these pots were added small quantities of nitrate, and it was found that most plants responded to its application ; that where no nitrogen was added, the plants died down after using up their reserve material ; whilst where it was added, they grew very much in a degree corresponding to the amount of nitrate added. Those of the leguminous order, however, did not so respond, or not to the same degree In the next place these experiments added a small quantity of an aqueous extract of a fertile soil (containing only very minute quantities of nitrogen and other plant-food), with the result that some of the *Leguminosæ* at once commenced a vigorous growth. Other members of this order, however, did not respond to the application of this particular soil extract. Lupins, for instance, did not so respond. When, however, an aqueous extract of a soil, on which lupins were growing freely, was added to the sterilized soil, the lupins grew perfectly, and this behaviour was not dependent on the addition of nitrates, for provided the small quantity of the soil extract were given, these

leguminous plants were apparently not dependent on additions of combined nitrogen.

Increase of Nitrogen.—Whilst, therefore, the growth of plants of other orders was dependent on a supply of *combined* nitrogen, and their growth was measurable within certain limits by the amount of nitrate added, the growth of the *Leguminosæ* appeared to be *dependent on something else*, and they grew luxuriantly with the aid of the addition of a little soil extract containing only very minute quantities of combined nitrogen. Lastly, *if the soil extract were sterilized* as well as the soil in the pots, they failed to grow. In the next place the amounts of nitrogen (small though they were) present in the sterilized sand, in the seed used, and in the soil extract, were determined. Also after these leguminous plants *had been grown, the nitrogen was determined in the pots* and in the whole plant. The total amounts of these quantities before and after the experiment were largely different; the final was indeed several times as great as the initial amount. Hellriegel and Wilforth's experiments have since been repeated by several workers on this interesting problem, and the result has been uniformly the same.

Root Tubercles.—Another matter must here be referred to. It was observed that the plants of this order included in the various experiments, had peculiar nodular formations on their roots. What the exact relation of these is to the assimilation of free nitrogen has not yet been definitely explained. That there is some relation seems to be extremely probable, for where these plants have *been grown in sterilized* soil and without soil extract, no formation of nodules takes place. Then, too, it was found necessary in the case of certain leguminous plants, in order to successfully inoculate the sterilized soil, to add, not an extract of *any* soil, but an extract of *some particular* soil,—such a one, indeed, as was then supporting the particular plant in healthy growth; similarly, it had been noticed that the nodules on the *different leguminous plants have characteristic forms peculiar to* themselves. It is, however, unnecessary to pursue this subject farther.

These results do not necessarily contradict those obtained originally by Boussingault and by Lawes and Gilbert, who showed that plants, the *Leguminosæ* included, did not, when grown in *sterilized* soil, assimilate nitrogen from the air. Hellriegel's experiments indeed introduced an entirely novel feature into the question, namely, whether lower organisms do not in common with the *Leguminosæ* assimilate atmospheric nitrogen. It is this problem which has now, since the publication of the results of the experiments above described, been engaging the attention of a number of bacteriologists. They are still in progress, and although a great amount of time has been devoted to the subject, the matter is still but imperfectly understood.

Practical Results.—The practical result of Hellriegel's and of Wilforth's work is nevertheless clear,—namely, that whilst plants of most Natural Orders depend on combined nitrogen for their supplies of that element, the *Leguminosæ* are not entirely so; and when plants of the leguminous order are grown in ordinary cultivated lands, a gain of nitrogen to the soil is probably being effected. It is possible that the subject has an important relation to the economy of Indian agriculture. Dr. Voelcker in his recent report, points out at page 46 how very plentiful are trees and plants of this order all over India, and the question naturally follows, "To what extent are these continually supplying nitrogen for the use of other crops?"—(*Agricultural Ledger. No.* 7, 1894.)

DR. J. W. LEATHER,
Agricultural Chemist.

Peculiarities in the Distribution of Certain Indian Leguminosæ

So far as the reports, published by the biologists and chemists who have hitherto taken part in the investigations of the subject of plant assimilation of free nitrogen, are concerned, it would be less ambiguous to speak of the *Papilionaceæ* than the *Leguminosæ*. Dr. Voelcker, while making this reservation, adds—"No enquirer going over India could fail to be struck by the enormous preponderance of trees, crops, and even weeds that belong to the Natural Order *Leguminosæ*. Almost everywhere the babul (*Acacia arabica*) is seen with many other leguminous trees; gram (*Cicer arietinum*), *arhar* (*Cajanus indicus*), and numerous varieties of pulses, indigo, etc., are among the commonest crops, and highly nitrogenous; lastly, leguminous shrubs and weeds abounds, and are often spread on the land or ploughed in as manure. How can this be in a soil naturally poor in nitrogen?" The only tree mentioned by Dr. Voelcker (in the passage from which the above quotation has been taken) does not belong to the *Papilionaceæ*, while it is, as he very properly says, perhaps the most prevalent tree of the order in India; but its inclusion in a list of papilionaceous plants may be admitted as slightly misleading. On the other hand, there are many papilionaceous trees and bushes that are very prevalent, and which therefore belong to the group of *Leguminosæ* that has been demonstrated as forming tubercles on their roots. Of these may be mentioned the species of *Crotalaria*, *Indigofera*, *Tephrosia*, *Sesbania*, *Alhagi*, *Æschynomene*, *Uraria*, *Alysicarpus*, *Dugeinia*, *Desmodium*, *Mucuna*, *Erythrina*, *Spatholobus*, *Butea*, *Pueraria*, *Phaseolus*, *Vigna*, *Dolichos*, *Atylosia*, *Flemingia*, *Dalbergia*, *Pterocarpus*, *Pongamia*, *Derris*, *etc.*, These and such like belong to the Sub-Order *Papilionaceæ*. Some of them are genera that embrace many species, and a few of the

species, such as those of *Indigofera*, *Tephrosia*, *Alhagi*, *Spatholobus*, *Butea*, and *Flemingia*, are very gregarious, so that where met with at all they are often extremely plentiful. But with the exception of a few herbaceous forms of *Crotalaria*, *Indigofera*, *Tephrosia*, *Alysicarpus*, and *Desmodium*, practically none of the bushy or arborescent forms occur near cultivation, unless—a tree here and there. So also occasionally, along railway enclosures, *Dalbergia* and *Pongamia*, are met with as avenue trees, but these rarely, if ever, exist on the village sites. Taking India as a whole, the system of growing hedges around the fields is not practised, but where hedges do occur they are mainly formed by the prickly species of *Acacia*, *Prosopis*, *Cæsalpinia*, *Parkinsonia*, etc, so far as the *Leguminosæ* are concerned, *and these are not Papilionaceæ*. If one were asked, therefore, to mention the most prevalent wild forms of *Leguminosæ*, that are found in association with cultivation, the answer would have to be the species of *Cassia*, and *Acacia*, neither of which belong to the group of plants that have hitherto been observed as participating in the process of nitrogen assimilation through the agency of root tubercles

But vast tracts of India exist in a state of scrubby jungle. The soil of such regions is of necessity very poor, otherwise much of it might long ere now have been brought under the plough. It is significant in such localities that, as a rule, the prevalent vegetation in point of number of individuals belongs to the *Papilionaceæ*. Witness, for example, the waste tracts of the Punjab and Rajputana, where *Alhagi*, is perhaps the most abundant plant. So, again, the rocky uplands of Chutia Nagpur and the Central Provinces, where trees, bushes, or herbs of *Butea*, *Spatholobus*, *Ougeinia*, *Flemingia Smithia*, and *Abrus* occur every two or three yards over thousands of square miles of country, the more herbaceous species being often met with in great abundance. Witness also the still loftier mountain regions where species of *Indigofera*, *Desmodium*, *Vicia*, *Flemingia*, and *Vigna*, etc., dispute possession of the scanty soil.

In fact it would be difficult to think of an uncultivated region or forest tract where a very large percentage of the individual plants met with did not belong to the group of *Papilionaceæ*. And what is even still more significant, members of the *Mimoseæ* and *Cæsalpineæ* are, comparatively speaking, rare in such regions. Indeed, the contrast in this respect between wild tracts and the areas of cultivation is very great. Instead of the plants named, the Tamarind and the Babul dominate the village lands and the under vegetation (so far as *Leguminosæ* is concerned) is mainly *Cassia*, with, on the mud walls that separate the fields, a few papilionaceous herbaceous species such as *Desmodium*, *Alysicarpus*, or *Tephrosia*, and in the submerged fields of the lower provinces *Æschynomene*. But as weeds of cultivation there are remarkably few *Leguminosæ*, while the crops of that order belong to the *Papilionaceæ* entirely; and it is to these, and almost these

exclusively, that the renovation of the soil's supply of nitrogen, through the agency of root tubercles, must be attributed, and not to the wild *Leguminosæ* It is indeed noteworthy that there is no agricultural crop obtained from either the *Cæsalpineæ* or the *Mimoseæ*..

The part which the wild *Leguminosæ* play in preserving, if not in forming, the fertility of waste tracts is a question that should commend itself to the consideration of the Forest more than to that of the Agricultural Departments. If the views advanced by Hellriegel be confirmed, as applicable to all *Papilionaceæ*, then the inference would be unavoidable that in measures of re-afforestation, a prominent place should be given to the encouragement of the growth of papilionaceous bushes or herbs, (in the initial stages of such experiments), even although these might be of no value as sources of timber.—(*ibid*)

A. G. WATT.

Marram Grass in Australia.

A committee of the Legislature, appointed in 1852 to enquire into the means of preserving Cape Cod Harbour, in speaking of the beach between the ocean on the north and the channel of East Harbour which is all that prevents the sea from breaking over into Cape Cod Harbour—says :—"This tract consists of loose sand, driven about by every high wind, which throws it up in heaps like snow-drifts. The wind from any point from north-east to north-west, drives the sand directly from said beach into the channel of East Harbour, and is carried by a strong current into the north-west part of Cape Cod Harbour. The ocean on the north is wasting this narrow beach away in every storm, and the current in East Harbour channel undermining and destroying it on the south. The decay of said beach has been on the increase for several years ; it has narrowed within seven or eight years, by the tide that runs through East Harbour channel, from 8 to 10 rods. Where the mail stage travelled only one year since, is now the channel, with 6 feet of water at low tide, and from 12 to 14 feet at high water."

The first effort made by the State for the preservation of this important harbour appears to have been in 1714. The town was incorporated in 1727, and was at that time a place of some extent ;

but the inhabitants soon began to leave, and in less than twenty years it was reduced to two or three families. After the revolution the place revived, and is now a thriving town.

The object of the law of 1714 was to arrest the destruction of the tree and shrubbery on the province lands, and on the preservation of which it was thought the harbour depended, as they prevented drifting of the sand.

In 1824 commissioners were appointed by the State Government to examine the subject, and report what action was necessary to prevent the rapid destruction of the harbour. They recommended an Act to prevent the destruction of beach-grass, and reported that the sum of 3,600 dollars would be necessary to set out that plant, make fences, &c. The Legislature in 1826 applied to Congress for that sum, and Congress has, at different times, made appropriations to the amount of about 38,000 dollars, which seem to have failed in some measure to accomplish the object intended, and East Harbour is still rapidly filling up.

Many years ago, it was as customary to warn the inhabitants of Truro and some other towns on the Cape every spring, to turn out to plant beach-grass, as it was in the inland towns to turn out and mend the roads. This was required by law, with suitable penalties for its neglect, and took place in April.

A farmer of much practical knowledge concerning this subject says :—"Since the cattle have been kept from the beaches, by the Act of the Legislature of 1826, the grass and shrubs have sprung up of their own accord, and have, in a great measure, in the westerly parts of the Cape, accomplished what was intended to be done by planting grass. It is of no use to plant grass on the high parts of the beach. Plant on the lowest parts and they will rise, while the highest place, over which the grass will spread, are levelling by the wind. To preserve the beach it must be kept as level as possible."

Beach-grass is of little value, except to prevent our loose sandy beaches from being drifted about by the wind. We have but one species, and this is fast spreading over our upland, making it useless for cultivation. Land that would produce from 20 to 25 bushels of Indian corn to the acre, without any manure, twenty-five or thirty years ago, is now overrun with beach-grass, and will produce nothing else. If the dead grass is burnt off in the spring, it will make a pretty good pasture for cattle and horses. It keeps green longer than any grass we have. It can be cultivated from the seed or by transplanting. Our loose sandy beaches are the most suitable for its growth.

Beach-grass seems to require the assistance of some disturbing causes to enable it to attain its full perfection. The driving winds in some localities are sufficient, while in other places, where it does not thrive so well, it is probable that an iron-tooth harrow would greatly improve and aid its growth.

Propagation.—While this grass has been extensively used in Europe, probably for centuries, for binding coast sands, it does not appear to have been introduced into Australia for the purpose until recently.

The seed of the Marram grass was first introduced into the Colony of Victoria by Baron von Mueller in 1883, and by him entrusted to the Borough Council of Port Fairy for experiment on the barren shifting sand-hummocks fronting the coast line of Port Fairy. It has proved to be the most effectual sand-stay ever planted. Practical evidence of its value can be seen in the 50 miles of sandhills extending between Warrnambool and Port Fairy, now reclaimed by the Marram plantations, sown under the direction of Mr. S. Avery, the park ranger. So complete has been the reclamation of the lands, that where a few years ago not a sign of vegetation was to be seen, there now exists a succulent grass eagerly devoured by cattle, and growing to a height of 4 feet. Marram grass is practically indestructible—burning, cutting, or eating off only makes it thrive—while in exposed shifting sand it propagates as surely as in the most sheltered situations.

The grass is planted in rows at a distance of 6 feet apart, the space between the plants at least 2 feet. The depth to which each plant is put into the sand depends upon the nature of the sand. If in sand not likely to drift for two or three months, 9 inches is deep enough; but if very loose and shifting, the grass should be placed from 12 to 15 inches deep. A "plant" consists of as much grass as a man can conveniently hold in his hand, and care is taken to have the roots regular. The system adopted in planting is for one man to dig the hole, and another man puts in the plant, around which he well treads in the sand. After twelve months' growth the plants are fit for thinning out and transplanting.

Cattle are not allowed to graze on the grass until the roots become thoroughly established. It takes 3,630 "plants" to the acre; and there are about 2,800 "plants" to the ton, thus 1 ton 6 cwt. covers one acre. The most favourable time for plants is from 1st May to end of July. The grass retains its vitality, and strikes root after being out of its sand-bed for three months or more. (Melbourne *Leader*, 2nd December, 1893.)

Marram grass commences to flower in November, with us; in fact, waiting for the flowers has unavoidably delayed the present notice of this undoubtedly valuable plant. It flowers in July in England.

Marram Grass at the Cape.—The following account of the attempts to acclimatise the grass at the Cape, and some pertinent observations on the Port Fairy experiments, as detailed in the *Leader*, are instructive:—

As a specimen plant, *Ammophila (Psamma)* was introduced some years ago into the Botanic Gardens, Cape Town, by Professor MacOwan, and seed obtained from Lincolnshire, England, was sown on the D'Urban Road sands by Mr. Lister. The grass is

said to have grown well. It was naturally killed by the Port Jackson wattles sown with it, and it was afterwards abandoned as a temporary stay in favour of the native Pyp grass.

At Eerste River sands, 56 lb. of seed obtained from Vilmorin & Co, Paris, were sown *in situ* in 1892. The seed germinated only at the foot of the sandhill experimented upon, and from a small patch, not much larger than a good sized dining-table, 650 bundles of thinnings were taken. These have been transplanted on one-sixth of an acre of sand, in rows 6 feet by 2 feet apart, in accordance with the method described below. Other two-year-old plants will enlarge the Marram Nursery to about half an acre, and one-year-old plants have not been thinned.

The larger plants removed were fully 4 feet high, and thus, with the advantage of Cape Town refuse manure, have attained in two years, from seed, a growth equal to three-year-old transplants at Port Fairy. That Marram grass is not readily raised from seed appears to be shown in the demand made upon the Victorian plant supplies by other Australian Colonies, Africa, and India; but once germinated it seems to thrive amazingly. The actual yearly increase is not stated in the Port Fairy report. My impression, based upon the prolific growth of the limited number of plants at the Eerste River, is that, in favourable situations, and with manure it will quadruple itself annually.

In a few years thinnings should be available for distribution. To avoid heavy transport charges on large quantities of plants, probably the best plan would be to form a small nucleus plantation of 1 or 2 acres at a sheltered spot near the sands to be reclaimed. If such a plantation of 2 acres in one year doubled itself only, in six years sufficient plants would have been produced to reclaim 128 acres of sand. The probability is, however, that the increase would be more rapid.

The first essential measure to success appears to be the fencing in of the sands, to exclude cattle before the grass is mature, and to protect it afterwards in the dry season. The cost per acre of fencing will vary considerably, according to the shape of the sands and their geographical position. On the coast, for instance, with an ocean boundary, one side of the sands would be naturally protected, whereas an inland sand might require fencing on three, four, or more sides.

To arrive at an estimate from which to make local calculations, let us assume a sand-drift to be 1 mile long and half a mile broad —say, 320 acres in extent. Fencing can be erected in most parts of the Colony for £50 per mile, or less; say, £150 for the 3 mile boundary, or about 10s. per acre. Holes can be made in the sand, and the plants conveyed from the nucleus plantation and put in for £1 per thousand, say, 3,500 plants per acre equal £3. 10s. Allowing 5s. per acre for direct supervision—an ample charge on extensive works—a total cost of £4. 5s. per acre is arrived at, and on 320 acres would cost £1,360 to protect and plant.

"If a plough were used for drawing a planting furrow, and 'closing it again, the cost might be considerably reduced."—(*Journal, Department of Agriculture, Cape Town, South Africa*, 26th July, 1894).

Marram Grass planting by the Department.—This grass has been extensively planted by the Department at the sand-drift at Newcastle, in conjunction with the Maritime Pine (*Pinus maritima*) and the vexed question of how to deal with this drift, which, in times gone by, has been such a source of expense and anxiety appears to be in a fair way to settlement. The grass is flourishing splendidly, the area under the grass is increasing year by year, and quantities of the grass are each winter season sent away to public bodies and private individuals (in this and other colonies), who desire to resist the encroachments of coast sands Following is an extract from a letter received from a correspondent supplied by the Department, with specimens of the grass for experimental purposes :—

"I beg to report on the success of the experiment to grow Marram grass at Shell Beach, Middle Harbour, where the rootlets you kindly obtained for me some months back have been growing splendi lly, and already throwing out shoots 3 to 4 feet away from the main stems. My friend Mr. ———, who planted the roots, states that he put in a handful of manure with each root which no doubt assisted the quick growth of the grass, which is now about 2 feet in height, and of a deep green colour.

"Some rootlets that I planted at the same time as the above at Edwards Bay, Middle Harbour, have unfortunately been eaten down by cattle.

"I would strongly advise your department to plant the Marram grass along the Spit Road beach, Middle Harbour, where, if protected during the first year from cattle, it would afford protection to the embarkment along the road to the ferry, and also assist in reclaiming an extensive flat on the Pearl Bay side of the Spit."

The Department will be glad to supply experimental quantities of the grass to persons willing to plant it in suitable localities. There is no doubt it is far more efficient as a sand stay than the native *Spinifex hirsutus*, described and figured in the *Gazette* for December.

Fodder value.—In a report upon the grazing capabilities of the grass furnished to Baron von Mueller by Mr. Avery from Port Fairy, under date the 18th instant (November, 1893), he states :—"I generally put the cattle into the Marram grass enclosure after 'the first rains we get in April, and then allow them to graze 'there until the season begins to get too dry, when they are taken 'out and kept off till next season. I have been able to keep them 'longer in this season on account of the late rains we have had. 'During the last season I have had about 100 head of cattle graz-'ing on about 100 acres of Marram grass for six months, and the

'cattle kept in fair condition during that time. There seems to 'be some doubt in the minds of a great many persons who have 'heard about Marram grass that it is of no value as a fodder, but 'I can assure you that the cattle at Port Fairy thrive well on it, 'and if it was not for this grass during the winter months the resi-'dents' cattle would fare badly. I am of opinion that it would 'make a splendid ensilage.—*Melbourne Leader*, 2nd December, '1893." Mr. T. E. Willis planted some Marram grass at Edwards Bay, Middle Harbour, but reported that they were eaten down by cattle. Baron von Mueller (*Select Extra-tropical Plants*, 1888 edition) says :—"Like *Elymus arenarius*, not touched by grazing animals." Dr. George Vasey says :—"This grass has no agricultural value." At Cape Cod Harbour the grass does not appear to be used for grazing purposes.

These statements may be reconciled as follows :—When fully grown, the Marram grass is notoriously a strong, fibrous grass, beyond the power of cattle to digest, even if they are able to masticate it, but the young growth (and even larger growth if the season be moist and favourable), can be eaten by cattle, hence the protection a Marram grass plantation requires at this most critical period of its existence. It is a matter of common knowledge that many of our native tussocky and other grasses are browsed upon by cattle, while young and fairly succulent, but, on account of their harsh and wiry nature, they are absolutely uneatable when fully grown. The use of Marram grass must always, therefore, be very subordinate from the point of view of the pastoralist. Its value is that of a coast sand binder.

At the same time the question of keeping cattle away from newly-farmed Marram grass plantations must never be lost sight of. Fodder in such situations is harsh and sparse, and stray cattle will readily bite at the comparatively tender Marram plants just coming into growth, and perhaps exterminate a plantation unless checked.

Since the above was in type, I have received the following letter from Mr S. Avery, of Warrnambool, Victoria, which shows that the grass is a really valuable fodder-grass :—"The Marram grass is edible during the whole of the year, and cattle will eat it at any time, but while there is plenty of rye grass and clover on the flats during the spring the cattle prefer rye grass and clover to the Marram grass, but as soon as the grass begins to get scarce on the flats the cattle then take to the sandhills and feed on Marram grass during the winter months, and thrive well on it. Before the Marram grass was introduced into Port Fairy, the cattle running on the flats along the sea coast used to suffer severely from scouring, and a great many used to die from that cause, but now you will never find a beast scoured that grazes on the Marram grass plantations, it being of a binding nature as well as fattening. The Macram grass will only thrive well on barren sand-drifts

where it is impossible to get anything else to grow, and the greater the sand-drifts the better it thrives, and as a sand-stay it cannot be equalled."

Habitat and Range.—Shores of Europe and North Africa. Dr. George Vasey also states that it grows on sandy beaches of the Atlantic, at least as far south as North Carolina and on the shores of the Great Lakes, but so far it has not been recorded from the Pacific Coast. It is, however, not indigenous to the United States, though from the account which has been given of Cape Cod Harbour it will be seen that it has been thoroughly acclimatised on the American continent.

J. H. MAIDEN.

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Wood-pulp Mosaics

A German has lately invented a process for manufacturing floor mosaics from woodpulp, of which the following is a description :—Several particles of wood, such as saw-dust, fine shavings, &c., are soaked in a mixture of shellac and alcohol, so that the pores of the wood are penetrated and thoroughly dried. A cement, consisting of fresh cheese whey and slacked lime, is then prepared. This cement is thinned with water, and then mixed thoroughly with the already dry wood particles in such a way that the consistency of the mass is uniform. Particular care is taken to render the cement as thin as possible, so that it will distribute itself easily and uniformly, and enclose each particle of wood as perfectly as the shellac solution. The mixture thus produced is allowed to dry until it is only moist, not thoroughly dry as before, for in the latter case the curd would lose its cohesive power. The moist pulp is then put into heated mosaic moulds of the desired shape and size, and in these forms placed under the press. As a result of the heat the shellac softens, regaining its adhesive powers, and the curd cement hardens rapidly, so that both of the substances, the shellac as well as the cement, unite under the pressure so perfectly with the wood particles that the wood mass resulting may within a few minutes be taken out of the moulds without losing the form received. After the cooling process and complete hardening, these mosaics, it is claimed, are far less susceptible to any change of temperature or moisture than any natural wood. It is necessary that the use of every other ingredient, especially if of an oily or fatty character, should be avoided in this character, as otherwise the close union of the shellac with the curd cement would be retarded or even prevented. Wood-pulp or the manufacture of multi-coloured mosaic is prepared in the following manner :—The particles of different varieties of wood are put through the process separately, so that the natural colour of the wood itself is brought into prominence. Dyes dissolved in alcohol

are mixed with the shellac solution before the wood particles are coated. The wood particles are first coloured with dyes dissolved in water, and allowed to dry well before coating with the shellac solution. For simple floors it suffices to manufacture mosaics of different colours, changing them at pleasure, so as to form a variety of patterns. The manufacture of pattern or fancy wood mosaics is proceeded with as follows :—Pattern moulds of the required design divided into fields and figures are fitted into the plain mould; each section of the design is filled with the wood-pulp, dyed as before described, and the pattern mould removed, after which the whole, thus freely outlined, is subjected to heat and air pressure as before mentioned, the result being perfect vari-coloured, fancy mosaic. This wood mosaic, in spite of its hardness and resisting qualities, still retains all the essential properties of wood, being adapted for use as floor covers in living-rooms and similar purposes.—(*Timber Trades Journal*).

Chemical Woodpulp.

Abstract of a paper read at the Imperial Institute by Mr. S. P. Eastick, Sir Henry Tyler in the chair.

The manufacture of woodpulp or wood-cellulose is an industry which occupies an important position in both the Old and in the New World The rapidity of progress of this branch of technology is a marvel among modern enterprises. For example, in the United States there were in 1886, 97,000 tons produced, while last year the quantity probably exceeded 1,000,000 tons, having a market value of over £5,000,000. In the United States alone 500,000,000 ft. of logs, represented the destruction of 100,000 acres of forest, are now annually utilized for pulp manufacture. It is estimated that the daily editions of the *New York World* absorb about seven acres of an average forest. Although originally intended for the manufacture of paper, woodpulp has been largely adapted to other purposes. By various methods of indurating and otherwise treating the pulp, it has been successfully employed for the manufacture of all kinds of furniture, of carriages, wheels, portmanteaux, kitchen utensils, barrels, water pipes, floor covering, doors, buildings, and ornaments, and, in the United States Navy, for protective purposes The fibres have been spun and woven into garments and blankets, the rugs are produced therefrom at about half the price of those of wool. In Hamburg a complete hotel has been built of woodpulp In surgery it is largely employed as a medium for applying antiseptics to wounds, for bandaging and other purposes. It can be dyed to any colour and shade, and can be rendered fire and water-proof. The first suggestion as to the possibility of making paper from wood appears in an essay published by Reamur in 1719, and in France specimens of paper were made from the bark, leaves, and wood of various trees in 1750. In the

first year of the present century a paper-maker, Mathias Koops, succeeded in producing paper from straw and wood, which he used for printing a book upon the subject. The manufacture of ground woodpulp is the invention of a Saxon watchmaker, Keller by name, who, in conjunction with an engineer named Volter, constructed a machine for the purpose. The present mode of producing this material is essentially that of Keller and Volter, with some improvements.

The class of wood used for the manufacture of pulp by chemical processes is known as soft-wood, and belongs to the order *Coniferæ* or cone-bearing trees. The common spruce and the silver fir are the chief species that supply the "chemical" woodpulp of Europe, while the white spruce, black spruce, Canadian hemlock, white American pine, and the silver fir furnish the bulk of woodpulp in America. For the production of woodpulp by mechanical processes, poplar, aspen, spruce, and fir are mostly used. Although every class of wood can be converted into pulp, only the soft coniferous trees are suitable. Trees having a diameter of 6 to 20 in. at the base, and of about 20 years' growth, are considered best. The great majority of pulpmills obtain their supply of wood in the form of round logs about 6 to 10 ft. long, while in some districts, edgings and waste from the saw-mills, board ends, battens, and even old packing cases, are used for making pulp. Sawdust has been experimented with for the purpose of making "chemical" fibre, but owing to the difficulty of securing its thorough penetration by the solvent liquor, and to other troublesome features, its use has been found impracticable.

In Europe—Scandinavia, Russia, Austria, and Germany possess the largest woodpulp forests, which, excepting those of Germany, are the natural virgin growth, and are still very extensive, notwithstanding the enormous quantities annually cut. In Germany the original natural forests have been almost exhausted, but new plantations are grown upon their sites under Government supervision. Undoubtedly the American continent has the largest supply of pulpwood, and immense virgin forests of suitable wood in Canada and Newfoundland are still practically untouched, but great demands will, at no distant day, be made upon these forests.

The appellation "woodpulp" includes, as already indicated, two distinct varieties of pulp, having different compositions and properties. These are known in commerce as "mechanical"—or ground woodpulp and "chemical" pulp or wood cellulose. The former is simply wood ground to a pulverulent or sawdust-like material, washed and made into sheets, while the latter or chemical woodpulp is produced by treating the wood with chemicals which remove the lignose and mineral components, leaving the cellulose-fibres almost pure. Of "chemical" pulps there are several varieties named according to the chemical agents employed in their manufacture—thus there are "sulphite" wood fibre, "soda"-fibre, and "sulphate"-fibre or pulp, prepared by the action of sulphite of

lime, caustic soda and sulphate of soda respectively. The lecturer described the manufacture of "chemical" woodpulp or cellulose by the aid of diagrams of the various apparatus and machines employed, and by samples of the intermediate and finished products, together with specimens of different qualities of paper produced from these pulps. Of the various countries manufacturing woodpulp, the United States, so far as quantity is concerned, stands foremost. The Canadians are beginning to realise the advantages they possess for the development of this industry. As a suitable country for the production of woodpulp Canada stands, indeed, among the foremost in the world; it possesses vast forests of suitable wood, whose quality cannot be surpassed; it has magnificent rivers for transporting logs and produce, and enjoys the advantages of numerous seaports and low ocean freights to Europe. It seems incredible that United States manufacturers have gone to Canada for their supplies of wood, manufactured it into paper, and then exported the paper into the Canadian markets. The value of the paper imported into Canada from the United States alone amounted in 1893 to 730,000 dollars, in addition to which they largely imported from Europe.

It is to the interest of Canada to encourage the exportation of wood, and at the same time to manufacture on a large scale both pulp and paper. The removal and utilisation of the timber and the conversion of vast tracts of forest into land suitable for rural settlements would benefit the country. It is satisfactory to find that one or two Canadian firms have been enterprising enough to commence exporting woodpulp to this country, and have most successfully faced competition with Scandinavia. The quality of the pulp manufactured by them is of a high standard, and is certainly equal, if not superior, to any of European make, and although to a large extent excluded from the United States by a high tariff, it should find a market in Europe.

A brief reference was made to our oldest and, perhaps, our most unfortunate colony, Newfoundland. This country, from the earliest settlement, has depended upon its fisheries, while its great natural wealth, which, for want of enterprise and capital, lies dormant, might convert it into a most prosperous colony. Besides being rich in minerals, a large proportion of the country is covered with a dense virgin forest of the trees most suitable for woodpulp manufacture, the cost of which would be considerably lower than in the most favourable districts of Canada or Scandinavia. Pyrites, available in the production of "chemical" wood-fibre, are to be found in various parts, while pure water and immense water-power are to be met with in localities convenient for the erection of pulp mills. Unfortunately the colony has the reputation of being an Arctic ice-bound country; such, however, is by no means the case. Some of the bays and rivers are blocked with drift ice for several months during winter, but on the southern coast there are bays, such as Placentia Bay, which are open for shipping all the year round.—(*Timber Trades Journal.*)

Woodlands in Sussex.

The cultivation of underwood as a source of annual income and profit has probably been carried out to a greater extent in Sussex and the surrounding counties of Kent, Surrey, and Hampshire than in any other part of England; therefore some account of the system pursued may be of interest.

Plantations here are formed almost invariably for the growth of underwood, and but seldom for that of timber, oak being indigenous to the soil, freely reproducing itself from self-sown acorns; care in preserving the tillers as they come up, and their proper thinning as they increase in growth, being nearly all that is necessary to ensure a crop of timber.

The woodlands may be divided into three classes; 1st, land wholly under timber; 2nd, lands partly under timber and partly under wood; and 3rdly, plantations wholly under wood, the second class forming the principal portion. The underwood, on these lands being formerly composed almost entirely of hazel has of late years been much improved by filling up the bare and vacant spaces with ash, birch, or Spanish chestnut. Plantations that are of comparatively recent date are formed, in some cases, altogether of Spanish chestnut, where the soil is found suitable to its growth or of a mixture of ash, birch, and chestnut; willow and alder are also planted in damp or boggy situations.

The underwood is sold chiefly by public auction, the sales taking place from the middle of October to the end of November in each year in lots of about two to six acres, although frequently larger and smaller lots may be put up, depending on the size of the plantation or the quality of the wood, the price being generally at so much per statute acre, but sometimes by the piece. The age at which the underwood is cut varies from eight to twelve years' growth, plantations being cut at an earlier age than underwood grown beneath timber. Good planted stuff will fetch from £2 to £4 per acre per year's growth, £30 to £35 per acre being generally the highest price made, average planted stuff of eight or nine years' growth selling at from £16 to £25 per acre.

The underwood is principally converted into hoops for barrels, tubs, &c., the wood being split, shaved, and tied up into bundles in lengths of 14 feet (the longest size) down to 2½ feet, 60 pieces making a bundle of 14 feet and 360 pieces a bundle of 2½ feet, 30 bundles making a load of hoops in all lengths. Hazel is generally converted into hurdles for folding sheep, whilst ash is frequently picked out for hop-poles, the trimmings and very rough, crooked stuff being made into bavins or fagots for fuel.

The conditions under which the underwood is sold are pretty generally as follows, although they vary somewhat in different localities:—

"Except that the auctioneers reserve the right of refusing a bidding, the highest bidder to be the buyer, and if any dispute

arise between two or more bidders the lot shall be immediately put up again.

"No person to advance less than five shillings at each bid, and shall not retract his bidding.

"The underwood of the lots stated to be sold by the piece, and in lots the measurement of which is stated to be *actual*, shall be taken by the purchaser at the quantity stated. 'Actual' measure means when the piece has been measured before, and the quantity is therefore known. The purchaser of each lot shall immediately after the sale pay to the agent of the seller a deposit of not less than 20 per cent. in part payment of the purchase-money, according to the estimated measurement, and give approved security for the payment of the remainder to the seller or his agent on or before the 5th day of May next, before which day all the lots, except the lots sold as actual and by the piece, shall be measured by the surveyor of the seller; and in case of non-payment of such remainder of the purchase-money on or before the said 5th day of May, the seller after such default (without prejudice to any other means for recovering such purchase-money) shall be at full liberty at any time to seize, retake, retain, and resell the said underwood, or if wholly or in part converted, the produce thereof, and wheresoever or in whosoever's possession the same may be, for making good the purchase-money or such part as shall remain unpaid. If the remainder of the purchase-money shall not be paid on or before the said 5th day of May next, the purchaser shall pay interest on the unpaid purchase-money from that day at 10 per cent. per annum. The purchaser of such lot or lots as shall make immediate payment of the purchase-money an allowance or deduction of sixpence in the pound on the amount paid (not including the deposit) will be made, subject to final settlement when the lots are measured.

"All tillers and trees shall be carefully preserved and left uninjured by the purchaser, and if any such shall be cut or injured the purchaser shall pay treble the value of the same; and all damages, with the expense of assessing the same, shall be paid to the seller or his agent within seven days after publishing the award of the referee, as appointed in the last condition. The purchaser shall leave uncut such a reasonable number of plashers as shall be marked or set out by the woodward of the seller, for which plashers the purchaser shall receive payment at the rate of sixpence per score; and the purchaser shall allow the seller or his servants to take, without making any allowance, so much underwood as shall be required for making good the fences.

"All the underwood shall be severed from the stem on or before the 25th day of March next, and the fagots and other produce shall be stacked by and at the expense of the purchaser in such places only, and not elsewhere, as shall be pointed out by the seller's surveyor, or by the woodward, on or before the 30th day of April next, and the whole shall be entirely cleared from off the lands

of the seller on or before the 29th day of September next (except in certain specified lots which may remain until the 1st day of March in the year after next), or become forfeited to the seller. And in all cases the purchaser shall make use of the accustomed roads only, except only on occasions when any other road may be pointed out by the woodward; and all other new roads made by him or them will be accounted as wilful damage, and be assessed, and payment thereof enforced, according to the last condition.

"Upon failure or neglect of complying with the above conditions, the deposit money shall be forfeited to the seller who shall be at full liberty to resell each lot or lots, or the goods converted from the same, either by public auction or by private contract, and the deficiency, if any, by such resale, with all charges attending the same, shall be made good by the purchaser at this sale and be recoverable as for liquidated damages.

"Lastly, all damages and other charges arising out of the infraction of any of the foregoing conditions, or any matter or things relating thereto, shall be submitted to the sole umpirage of the auctioneers at this sale, or some person appointed by them in writing, such award to be binding on all parties And such umpire shall have all the powers of an umpire appointed under the Common Law Procedure Act, 1852."—(*Timber Trades Journal*)

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Note on the Patiala Western Siwaliks.

The situation and general condition of these Khols* is so well known that no lengthy description is here called for, and it will be sufficient to note that they form a low range of hills rising in elevation to 2,050 feet, and running from the right bank of the Ghaggar river parallel to the outer range of the hills, upon which Kasauli is situated, and from which they are separated by a long narrow valley locally called the Dun.

Their course, therefore, is virtually from south-west to north-east, *and their length* to the Nalagarh State boundary some 12 miles in a straight line; the width of the range is considerable, but that of the portion owned by the State varies from 3 miles to one mile, following the boundary of the Umballa District. In Kala Teep the slopes are moderate, but elsewhere they are generally precipitous to steep.

2. As a whole, the soil may be described as a very soft, friable sandstone, intermingled with bands of a sandy clay. Except, therefore, when well covered with vegetation, a state of affairs, which is unfortunately very rare, the soil is easily eroded, the pure sand is carried away by the rain alone, and the hot sun splits the surface of the clay into innumerable cracks, so that the rain when it comes carries masses of it down into the Nallas. Under these circumstances landslips are, of course, very frequent. It should be noted, however, that the most southerly portion of the ridge, which adjoins the Ghaggar river, is formed by a well defined rounded hill known as Kala Teep. The soil here is different to that in the Khols *proper, for it seems* to partake much more of what is known as a boulder formation; it is much less liable to erosion, and very much better covered with vegetation than the rest of the area.

3. Kala Teep is a fairly well stocked scrub jungle, formed of the usual species to be found in the low hills. In some portions of the Khols, too, the vegetation is pretty good, for instance in parts so situated that owing to their distance from the villages they are naturally protected against excessive grazing in sheltered

* *Khol* is Hindi word, meaning literally a hollow; here used for ravine.

Nallas, and commonly wherever the soil is more stable than usual. In such situations Chal is the predominating species, while a few Khair, Shisham, Amaltas, Dhak, &c., are to be found mixed with the inferior bushes. But over the greater part of the area vegetation is very scanty, indeed, and may be said to be generally confined to scattered stunted bushes of Korannda and Kuri with a moderate growth of grass.

4. Up to about the end of the year 1885 this range was open to unchecked grazing of all kinds, both of State and of foreign cattle, while the portions in the neighbourhood of Kalka, but more especially Kala Teep, were exposed to indiscrimnate cutting, lopping and even stubbing out roots for charcoal and lime burning, in addition to the ordinary lopping for fuel and fencing carried out by the people. Felling of all kinds was then prohibited, and in 1887 the whole of the Kala Teep hill was closed to grazing, but subsequently in 1891 it was found necessary to again open a small portion of it to provide for the grazing of the neighbouring village cattle. The grazing of foreign cattle has also been stopped throughout the whole range, and, as far as possible, lopping for fodder prohibited, while a few years ago 9,298 acres of the range were demarcated as State Forest.

The forest settlement, carried out by Mr. Minniken, *provides* that one-third of this area may be closed to grazing, and accordingly taken up, until at the present time there are altogether 14 portions of the forest closed to grazing; three of these:—Kala Teep 725 acres, Nagaranwali Khol 127 acres, and Khol Khera 775 acres —are closed to grass cutting as well as grazing, the remainder to grazing only. The total area closed, however, has not yet been brought up to the limit allowed by the settlement.

5 The first attempt at any kind of reboisement work was made in the year 1887 when a quantity of Kikar seed was given to the Zamindars who were made responsible for sowing it throughout the Khols. Not much could be expected, of course, from this kind of work, but still there are a fair number of fine young Kikar trees to be found in most of the Khols as the result of these sowings. Then in 1888-89 the State Forest Department carried out successfully Kikar sowings in waste lands along the bank of the Sirsa river at the foot of the Khols, but a good deal of this land has been subsequently carried away by the river.

The main reboisement work, however, is confined to the Nagranwali Khol which, three years ago, was taken in hand with the intention of forming a regular plantation, the objects being, firstly, to control and regulate the small Nallas, and then with the aid of planting and sowing to prevent landslips and the formation of destructive torrents, and finally to transform a useless and indeed a dangerous area into a useful and revenue yielding plantation. For this purpose commencing at the top of the area a series of small bunds are built across the course of the little Nallas; these bunds

are constructed any time between the close of the winter rains and commencement of the rains proper, and made either of loose stone work or of large cuttings of Jhingan, Thor, Pindara or Kharpat bound with Maghan ropes. Their effect is to arrest the loose soil brought down with rain, and so raise the level of the little Nalla bed behind them to the top of the bund which, if not themselves carried away, they generally succeed in doing in the one rainy [illegible].

At the commencement of the next rains the soil so collected is planted up with strong plants raised in the Pinjour forest nurseries, and put out by the method known as "basket planting," while at the same time attempts are made to steady the sides of the small Nallas by putting out quickly growing grasses and strong nursery plants according to the slopes of the hill side as the upper portions of the area are successfully treated, this work will be gradually extended downwards, until at last the whole of this plantation has been dealt with.

At first planting with the species noted at foot* was alone relied on, but during the rains of 1894, a good deal of sowing of Kikar, Shisham, Khair, Siris, Dhak, Bahera, Maghan and Kuri was carried out on the easier slopes of the upper portions of the plantation, while within the past month 500 strong *Robinia pseudacacia* plants, obtained from the Simla nurseries, were put out along the ridge. It is to be noted that during the first hot season after being put into the plantation the plants are watered twice, and thereafter are left alone; many of the transplants, therefore, have now passed through one hot weather without being watered, and without suffering in any way whatever. Work of this kind cannot, of course, be successful all at once, for landslips carry away the bunds and cover up the young plants, but still considering the short time the work has been in progress a marked measure of success has been obtained, quite sufficient, I think, to show that if the work is continued the ultimate reboisement of this Khol is only a matter of a little time and money, for the great majority of the transplants are growing splendidly, while the sowings of the last rainy season have given very good results, and generally the condition of this Nagranwali Khol, after only 3 years' treatment is in striking contrast to that of the unprotected Khols along side it.

In addition to the work in the regular plantation the last two years have seen scattered sowings of Kikar, Khair, Babera, etc., carried out in a number of the other areas closed to grazing; beyond that it is sincerely to be hoped that they will be continued and extended; they call for no remarks because they have been confined to the "Tappars" or flat places, very probably old cultivation, which are to be found here and there in the Khols above

*Shisham, Khair, Bamboo plants and cuttings, Bahera, Siris, Jaman, Jamoa Mulberry, Maghan, Bhabar Grass, Munj Grass, Khura Grass.

the Nallas, and because as long as grazing is excluded the re-stocking of such areas presents no difficulty.

The whole of the work now under reference, that is to say, the closure to grazing, the plantation and the sowings have been carried out by Pundit Sunder Lal, the State Forest officer, who deserves great credit for the energy and ability he has displayed. He would not have been able to accomplish so much without the aid of the great interest in forestry for which the late Commissioner is well known, but I believe I am right in saying that his reboisement work in the Nagranwali plantation, is the first serious effect that has been made in the province towards reclaiming any of these denuded low Siwalik Hills.

6. For the discussion of this question the forest may be divided into two portions :—

(*a*). The Kala Teep Hill.

This is already well wooded, and so all that is necessary is to keep grazing excluded, or at any rate well restricted. For the purpose of improving the value of the forest, it would be well to put out bamboos in the Nallas, as there is little doubt of their success, and as they would sell well in Kalka.

After a few years more rest, I think that a regular system of working might be started here, coppice with fairly numerous standards would probably be the best.

(*b*). The remainder of the Khols.

The importance of continuing the work of re-afforesting these Khols cannot be over-estimated, for those not yet under treatment are going from bad to worse, and it is a matter of common knowledge that here, just as in Hoshiarpore, the gradual but certain result of leaving them unprotected is the destruction of the cultivated lands at their base, and a consequent loss of revenue.

For this purpose a sufficiently large sum should be set aside by the State every year for the up-keep and extension of those works ; the direct benefit would be by no means inconsiderable, for once plantations, such as in Nagranwali, are formed, there will be a large and sustained yield of wood and grass for which a ready sale would be found, as the Khols are close to Kasauli and Kalka.

I think their treatment should be as follows : -From the area which the settlement allows to be closed as many Khols as possible should be taken up by the State with the view of forming permanent State plantations like Nagranwali, these should be treated in the manner now in force for this plantation, that is, by Gharabandi, (the local name for the construction of the small bunds) planting and sowing. The species used should be much the same as at present, though I believe that bamboos for the sheltered situations, grasses for the very steep bad hill sides, and Khair, Shisham and Kikar in general will be found the least ; it is too soon yet to say anything for certain about the *robinia*, but if this species succeeds, and I believe that it will, it should be adopted wherever

possible, for, apart from the fact that it would give a very large fuel yield, it is a species with great development of lateral roots, and, being at the same time very prone to throw out root-suckers, it is exactly what is required for binding together loose and friable soil such as that under consideration.

In addition to these plantations the settlement closure limits should then be worked up to so as to pass over all of the other Khols in rotation by which means their condition would be gradually improved. The closure should be for ten years, for the first two of which grass-cutting might be allowed, then in the third year the area should be gone over and blanks sown up with a mixture of Kl air, Shisham and Kikar, after which grass cutting should be prohibited for five years; in the ninth and tenth year the grass might again be cut, and in the eleventh year the area thrown open to grazing in exchange for another Khol to be closed in its place.

Forest Soil.

It was Darwin's researches which first called the attention of scientific men to the part played by earth-worms in the formation of soil; but what is less generally known in France is that the English scientist mentions, in the introduction to one of his works, that a correspondant of his, Mr. King, had heard the professor of 'aménagement' at the Nancy Forest School describe to his class the work done by earth-worms as a splendid example of natural culture, the dead leaves being covered year after year by matter brought up from below, the result being a rich humus soil of considerable thickness. It is not without a certain amount of legitimate pride that we thus mention here this testimony to the teaching of our professors

This point being established, we now feel more at liberty to enter into a description of a new work on the earth-worms from the pen of the indefatigable Director of Forests in Denmark, Dr. Müller.

At the time Ray Lankester was studying the anatomy of worms, Darwin, with the patient genius which characterized him, was studying their habits. He showed that in swallowing portions of humus and assimilating their nutritive principles, worms reduce the earth to a sort of paste, and so contribute to the improvement of the soil which they, at the same time, drain by burrowing through it. It appears, moreover, from these researches that the Oligochœta are the most active agents in covering up with regular layers of earth the remains of ancient buildings and such like on its surface, and that they thus assist in covering the earth with a thick mantle of vegetable soil, of which they increase the richness by the large quantities of leaves and other organic matter which they store up

in their burrows not only for food, but to conceal the entrance. Further, these holes greatly assist the descent of the smaller roots, and these derive their nourishment largely from the humus which covers the sides. Finally, large quantities of seeds owe their germination to the fact of their having been covered up and pressed down by rejected matter, others again buried at a considerable depth under accumulations of such rejected matter remain without germinating until some accident, perhaps, brings them to the surface again.

Dr. Müller, author of "The Natural Forms of humus and their influence on the vegetation of the Soil," is, we believe, the first who, returning to the doctrine of Thürmann, has attributed to the physical properties of the soil, so important to the forester, a preponderating influence on the distribution of plant species.

"Formerly," says Dr. Müller, "it was contended more forcibly than it appears to be at present, that the chemical character of the soil was the factor which determined the distribution of plants within the zone of vegetation. Although this view has been confirmed in certain particulars by recent investigations, the alleged importance of this factor has been considerably lessened in other repects, in all cases another more important cause of distribution, *i.e.*, the common life of organisms which is apparent in every locality, makes itself felt more forcibly. It is not, moreover, only groups of these organisms which are of interest, but also the most varied, acting together, have their influence on the soil, and also reciprocally limit their own development. The fact that leaf-eating insects may contribute to limit the development of a certain plant should be apparent to those who are acquainted with the conditions of the life of those insects which are found in masses on the plants on which they feed. But besides this the most different organisms are able to render the soil less habitable for certain species and more favourable for the development of others."

The above will permit those who are interested in questions of geographical botany to estimate the divergence of the views which separate the partisans of the exclusively mineral doctrine, amongst whom should be quoted, in the first place, the name of M. C. H. Conte'can, from the supporters of the influence of the physical properties.

It shows too the great importance which Dr. Müller attaches to living organisms in the influence they have on the physical properties of a soil.

For Ebermayer's classifications of humus deposits into fertile humus, powdery humus, acid humus and astringent humus, Dr. Müller substitutes for beech forests—(1) *Müll* or mild soil, (2) *Torf*, or carbonized humus, each of these formations being distinguished by a distinct fauna and flora.

In the former, animal life is extremely active, the earth being traversed in all directions by the galleries of earth-worms;

the upper layer of a black colour is gritty, friable and permeable. On the surface are found—*Mercurialis perennis*, *Milium effusum*, *Melica uniflora*, *Stellaria nemorum*, *Oxalis acetosella*, *Anemone nemorosa*, *Polytrichum formosum*. It will be noticed that many of the plants mentioned characterize in France also the soil of well kept forests. In "the Torf" of beech, there are neither moles nor earth-worms, the clotted, friable particles of earth denoting the abundance of animal life, and the excrement of insect are absent. Entomologists regard this peaty soil as sterile, and a few small eel-like animals only, which live in the moss and on the mycelium of fungi, are to be noticed here and there. *Aira flexuosa* and *Trientalis Europea*, together with the whortleberry, of which the rootlets, along with those of the beech, enter into the upper matted layer, are characteristic of the vegetable cover.

In addition to these characteristic formations Dr. Müller distinguishes—(1) *Peat-mould* noticeable in the oases scattered about in the midst of peat. Earthworms form, at these points, flourishing colonies, and clumps of brambles and promising beeches break the monotony of the miserable vegetation of the peat formation.

(2) *Insect-mould* is characterized by the absence of any matted superficial layer, and by the presence of a clotted sub-soil, formed by an enormous mass of insect excrement. Here the whortleberry is the predominating plant. The growth of the beech, though not all that could be desired is, nevertheless, better than on the peat.

(3) *Moss-mould.*—Soil compact, cohesive and dark, no matted layer formed by the beech roots, the organic and inorganic debris are bound together by threads of moss thallus. No worms and growth of beech poor.

(4) *Heath-peat* analogous to peat properly so called.

What are the principal causes which have led to the disappearance of mould and brought about the formation of peat? The author distinguishes natural causes and those resulting from the agency of man. The first are due to fires or the prolonged action of wind. The second appear to originate from badly made fellings. Peat is frequently met with in old, abandoned seed-fellings, or where excessive thinnings have been made.

Touching on the question next in its progressive stages, Dr. Müller endeavours to throw light on the future by means of the teachings of the past. Step by step he shows the forest vigorous on mild mould, and even on peat mould deteriorating on the insect mould dying on beech-peat, and finally becoming extinct on heath-peat. But he does not conclude as we should at once do, that all this means the final retreat of tree vegetation The cycle does not close with the heath. A legion of species of *Aira* and other Graminea spring up on the waste which, after a time, doubtless considerably long, will succeed in piercing this matted

cover and in re-introducing into the sub-soil that animal life which had disappeared from it, and without which forest growth cannot take place.

Each of these phases which mark the transformation of forest into barren waste is, moreover, characterized by a distinct fauna and flora, and a particular condition of the soil. Coloured illustrations show in a most striking manner the modification which the latter undergoes.

Space prohibits our following Dr. Müller through his description of the formation of the different kinds of humus and his study of the soil, suffice it to say, that these chapters are full of new and interesting facts.

In the second part of his work the author enters on the study of the forms of humus in oak forests, and distinguishes between forests of *Quercus pedunculata*, with an underwood of hazel, and those of *Q. sessiliflora*, with underwood of juniper. The former situated on clayey soil grow vigorously, thanks to the presence of a mild soil formed by the debris of the hazel, constantly improved by the action of earth worms; the latter vegetate slowly and with difficulty on a sandy soil covered with a formation of peat in which animal life is scarce, and the presence of thick cushions of mycelium filaments, binding together the organic debris, is noticeable. The crust of 'alios,' which originates from this peaty formation, rapidly transforms the forest of *Q. sessiliflora* into a waste of heath.

The transition from mould to peat, *viz.*, from forest to waste, is brought about by a succession of plants, such as may be seen under the stunted oak coppices.

"If the canopy of these shrubs commences to open out from 'below, or if the crown begins to dry up, first, the whortleberries, 'then heather and, finally, heath and tufts of Empetrum make their 'appearance, and the plants characteristic of mould withdraw to the 'more shaded parts. To the whortleberries and heath succeeds the 'formation of peat, until the moment when the bush is surrounded 'by sand. The causes of this transformation over small or large 'areas are the extension of a vegetation which forms peat consequent 'on the lessening of the cover and the protection of the soil." These are excellent observations. Otherwise it would have been said that the soil had become exhausted so far as the Oak was concerned; which is obviously not the case.

The form of the humus in the spruce forests of Denmark also presents interesting peculiarities. On good soil a carpet of moss is formed which collects and holds together all the debris of the forest and covers dark coloured mould of a porous and clotted character which bears witness to the activity of earth-worms. On hillocks of poor sand there is a formation of firm compact peat-like humus traversed by a tissue of five needles. The 'alios' begins to show itself. In mixed crops of spruce and oak we may notice

finally a formation of mould under the oak and of peat under the spruce.

From these observations Mr. Müller reasonably concludes that the deterioration of oak forests and their transformation into waste arise chiefly from important changes in the soil which are fatal to forest growth.

One might doubt from all these studies, depending on the magnifying glass and the microscope, whether the author in his practical conclusions had not lost sight of the forest in the mass of of minutiæ under foot; but this is by no means the case, and his conclusions are worthy of the skilled sylviculturalist, as witness the following page on the management and care of the soil in a beech forest:—

"The freshness and porosity of the soil are obtained by means 'which tend to preserve the leaf canopy. This influence of the 'leaf canopy should be attributed not only to processes of the 'inanimate world, but also to that organic life which inhabits a fresh 'and shaded forest soil. The work of the forester seems to be to 'assist the development of a mass of living organisms which work 'in secret for his advantage.

"Generally, the forester's aim will be to favour the formation 'of good mould and to protect the animal life which contributes so 'largely to its production. He can do this, by keeping the soil of the 'forest always sheltered, in taking care that the outer edges of the 'forest are provided with cover, and by avoiding the opening out 'of the forest too heavily or over too large areas during regenera-'tion. Too clear seed fellings have a most disturbing effect on the 'character of the area over which these are effected. The soil 'hitherto sheltered, moist, protected from winds and night frosts 'is suddenly exposed to all these influences from which it had been 'previously carefully guarded. If, in addition to this, we have a 'South or East aspect exposed to the full force of the sun and dry 'winds, or even if the soil is exposed to the West winds which 'blow away the dead leaves which hitherto protected the animal 'life in the soil, the transition becomes rapid. Every naturalist 'who believes in the relation existing between the physical pro-'perties of a soil, and the animal and plant life in and on it, will 'understand that a seed felling creates a totally different condition 'of affairs favourable to new forms of life and the suppression by 'these of other forms previously predominating. An area where a 'seed felling has been made is a totally different botanical and 'zoological site from a high forest of beech with complete canopy, 'and, if it is admitted that the nature of a humus is influenced in a 'sensible degree by the animal and plant life of the place, there must 'then be some change produced in the form of the humus. In like 'manner an excessively heavy thinning, any incautious clearing of 'the outer protective border of a forest, a badly executed selection 'felling, or other similar causes may lead to the same changes in

'the organic life of the forest soil, and produce the same phenomena as those which we actually meet with in nature."

Such are measures, applicable everywhere, which Dr. Müller recommends for the prevention of the formation of peat. But if this has already made its appearance over large areas, if the heath already shows signs of spreading vigorously, and if the forest under the combined influence of the various and numerous factors concerned gives indications of its total disappearance, more decided measures must be taken to restore artificially the conditions necessary for tree growth. Such works would include the spreading of branches on the soil to prevent the removal of the dead leaves from the edges of the forest where insufficiently protected from wind and sun; the breaking up by means of the hoe or plough of the felted surface of the peat in order to induce the reappearance of the more favourable forms of animal and plant life; finally, in crops excessively deteriorated the seed bearers, the natural disappearance of which is only a matter of time, might be removed and suitable species planted after a thorough cultivation of the soil: for example, oak and Scots Pine; taking care to maintain a proper mixture of light-demanding and shade-enduring species, and avoiding those, such as the spruce and beech, which have a tendency to induce the formation of peat.

We now come to Dr Müller's new work which constitutes a sequel to his researches regarding the natural forms of humus, and treats of the influence of earth worms on the growth of plants with rhizomes, especially in beech forests. Dr Müller first treats of the descent of plants into the soil. Hitherto the three principal causes, which have been given for this sinking down, are:—

1st.—The contraction of the roots.

2nd. The positive geotropic curving of organs.

3rd.—The law of a fixed level.

Without going into these separately it will suffice to say that Dr. Müller denies more or less the influence of all three, at any rate as regards herbaceous plants, and attributes the process chiefly to the earthing up by worms assisted by certain other purely mechanical influences.

Taking the plants which grow in beech forests, he divides them into several groups according to the place their rhizomes occupy in the soil.

First come the plants which, like *Asperula odorata*, *Oxalis acetosella*, &c., have rhizomes which develope between the dead leaves and the granular surface of the soil. "These plants are 'formed in such numbers that one might imagine that in spite of 'the frailty of their tissues they would at length form a sort of 'mat over the soil. This is, however, not the case; the stems of these 'plants gradually disappear from the surface, being slowly covered 'up by the matter ejected by earth worms. On the few points 'where this heaping up of earth by worms does not take place, the 'space comprised between the leaves and the soil is so interlaced

'with the small rootlets of trees, mycelia and root fibres of mosses, 'that a compact mass is formed into which the rhizomes do not 'penetrate. The heaping up of earth by worms is therefore necess- 'ary in this case to stimulate the developement of these plants."

Secondly, we have those plants whose rhizomes grow either between the layer of dead leaves and the soil, or in the upper layer of the soil itself. All these plants sink gradually down into the ground under the accumulations formed by worms If this action becomes reduced, or fails altogether from any cause, either a less active growth and production of flowers is the result, as with *Convallaria majalis*, or the roots dry up, as with *Epilobium montanum*

Next come the plants with oblique or vertical rhizomes, and here again direct observation shows the earthing up of the roots by worms, and their consequent sinking below the surface, in the case of such plants as *Primula elatior*, *Anemone hepatica*, &c., &c. *Plantago major* often hides under its spreading leaves the entrance to numerous galleries of worms, which cover up its surface roots.

Other instances and examples are given, and the author then proceeds to the general study of the change of vegetation according to the alterations the nature of the soil undergoes, consequent on the disappearance of the layers of dead leaves, the continuous action of atmospheric agents and the diminution of animal life.

"In these transformations from the sheltered and well covered 'soil of the interior of a forest to the borders exposed to the wind 'and sun, each step is distinguished by a special flora of herbaceous 'plants As soon as the leaves are blown away by the wind and 'the surface of the soil becomes hard, the plants with rhizomes, 'which grow on protected soil, disappear, and in a few years are 'replaced by a growth of plants with bushy, tufted roots, such as '*Luzula pilosa*, *Dactylis glomerata*, *Veronica officinalis*, *Poa nemo-* '*ralis*, *Aira caespitosa*, *Agrostes vulgaris*, *Holeus lanatus*; more- 'over by several plants which do not form tufts and have not either 'any under-ground stem: such as *Lampsana communis*, *Lactuca* 'muralis and *Hieraceum murorum*. If for a considerable number 'of years the area in question remains exposed to sun and wind, as 'may happen in the case of the borders of a forest, even this last 'mentioned abundant and often luxuriant vegetation also dis- 'appears, and is succeeded by a feeble, often miserable, vegetation 'even on rich soil."

All these facts, and others also which we have not been able to quote, permit of the conclusion that if, as the author shows in his first memorandum, natural humus varies considerably according to the activity of earthworms, and if each of the different forms of humus is tenanted by a special flora of herbaceous plants, it is clear from his last researches that the influence of earthworms on the character of the local flora is much more direct than would previously have been supposed.

"It is not really necessary that in a given place a totally 'different type of humus should be developed, in order that the 'vegetation may change completely; it is sufficient that the num-'ber of worms and the product of their labour become appreciably 'reduced for other forms of plants to invade the ground, and the 'biology of the vegetation to be essentially modified. The ac-'cumulation and elaboration of the friable and fertile soil derived 'from a clay are the result of the action of earthworms on it. In 'its original state it is a stiff compact soil, not habitable by the 'great majority of under-ground stems, but worms bring it into a 'condition especially suitable for plants with rhizomes, by reducing 'the upper layer of such stiff soils to that thoroughly friable con-'dition, as is met with in light soils whether of sand or lime and in 'swampy ground. When one thinks of the enormous extent of 'clay soils, and bearing in mind the fact that the greater part of 'the herbaceous plants which inhabit the northern and temperate 'zones are rhizome plants, one is able to understand the great 'influence the work of worms has on the flora of districts where 'such soils prevail.

'By earthing up the plant worms modify directly its biology, 'but they influence equally the nature of the outward form of 'metamorphosed subterranean stems. It has long been recogniz-'ed that the immediate influence of the surroundings on plants is 'considerable, and to this should be attributed the great divergence 'existing between aerial and subterranean stems. Among these 'influences that of worms occupies an important place.

'In many cases the existence of under-ground stems is a 'proof of the great influence which the fauna of the earth has 'exerted, and is constantly exerting, on the vegetation; it contri-'butes to the development of forms, to the well-being of individ-'uals, to the constitution and to the biology of the local flora."

Such are the outlines of the original work of Dr. Müller. Based on the study of nature it throws light on certain parts of vegetable biology hitherto obscure, and shows that all that takes place on and below the surface of the soil has its effects on tree growth. Modifications, almost insignificant, in the soil produce important effects on the forest, and may even lead to its disappearance.—(*Translated from "Revue des Eaux et Forêts," by A. F. G.*)

III.—OFFICIAL PAPERS & INTELLIGENCE

The following Circulars have been issued by the Government of India :—

Classification of Forest growth and Soils.

"It has been observed that, in all forest surveys conducted in 'the Central Provinces by the Survey of India Department, the 'nature of the forest-growth and of the soil is classified and 'recorded in addition to the topographical features. The Govern-'ment of India approve this system, and I am directed to request 'that you will be good enough to issue instructions for the prepa-'ration, in future, of a similar record for all areas surveyed by '"forest" parties of the Survey of India Department.

"2. The details required are naturally subject to modifications 'according to the different conditions of forests to be surveyed, 'and should in each case be previously settled in consultation with 'the Conservator of Forests acting under the control of the Local 'Government to which he is subordinate.

"3. Apart from the value which such classification of forest-'growth and soils has for the preparation of working plans, it is 'considered desirable that the Government should be in possession 'of reliable information as regards the existence and extent of 'areas included in the forest reserves which, owing to their con-'figuration and the depth and richness of the soil, may be suitable 'for permanent cultivation. Such areas should be marked by a 'distinct coloured boundary-line."

Memorandum on the system adopted in No. 14 Party (Hoshangabad) for the classification of forest-growths and soils.

To carry out the wishes of the Chief Commissioner and Forest Officers, Central Provinces, and after consultations with them, a system of classification of forests and soils was adopted and carried on at the same time as the original detail survey was made: the former by the *colours* of lines used for shading, and the latter by the *direction* of the lines. The classification was shown on tracing cloth by symbols as follows :—

The forests were divided into 5 classes, *viz.* :—

1.	Forest where teak abounds without bamboo	*Carmine.*
2	Ditto with do. .. .	*Blue*
3	Miscellaneous forest	*Brown*
4.	Grass lands	*Green.*
5.	Cultivation	*Yellow.*

Soils were divided into 4 classes, *viz.* :

1.	Very good and rich .	*Lines drawn vertically*
2.	Medium	*Do.* horizontally
3.	Very dry . . .	*Do.* *diagonally from N. W. to S. E.*
4.	Unproductive	*Do.* *do.* *from N. E. to S. W.*

Each sub-surveyor kept an outline trace of his daily work on a piece of tracing cloth, and also made notes of the soil and class of forests that he met with. At the end of a few days, when sufficient detail survey had been completed, he coloured up the portions and marked them with lines according to the fixed symbols. This trace

the sub-surveyor kept going until his work was done, and it was examined at the same time as the topographical detail. Some differences of opinion were found at the adjoining edges as regards nature of soil, more especially between the "medium" and "very dry"; but these were reconciled.

On compiling the different plane-table sections into standard sheets, was found that laying colour on to the tracing cloth spoilt it and rendered it opaque. The plan of drawing in the lines in their proper colour and direction was then adopted, and was found to answer all purposes, whilst the tracing cloth was kept clear and smooth.

The extra cost entailed can only be arrived at approximately. For the field work I have allowed that over an area surveyed of 4 miles square, or 16 square miles, a delay equivalent to the time occupied in surveying half a square mile was entailed, owing to the time spent in classification.

The season's outturn having been 353 square miles, at a rate of Rs. 180 per square mile, the loss entailed is equivalent to the cost of surveying 11 square miles = Rs. 1,980. The estimate for the mapping and compiling into standard sheets can be made more accurately, and it has been found to amount to Rs. 390. This with the cost of supervision, viz., Rs. 100, makes a total of Rs. 2,740, or Rs. 7 per square mile.

The fair trace is made over to the forest officers.

The classification of the forests and soils was arranged by Mr. Thomas, Deputy Conservator of Forests, Hoshangabad, and it applies to the forest of Hoshangabad and Betul only. A different classification would probably be required by other forest survey parties, and could be arranged for by the respective forest officers according to their requirements. But the system of classifying by means of colours and directions of lines might probably be adopted with advantage.

Preparation of Forest Estimates.

"The attention of the Government of India has been drawn 'to the tendency that exists to over-estimate the expenditure, and 'in some cases to under-estimate the receipts, in the budget esti-'mates of the Forest Department, as shown in the appended tables. 'This tendency, though general, is much more marked in some 'Provinces than in others; and appears, though in a less degree, 'in the revised estimates also. It seems to be partly due to a dis-'position on the part of Conservators and Local Governments to 'accept the figures of the Divisional Officers, without due conside-'ration of the actuals of previous years for the Circle or Province 'as a whole.

"2. The Government of India are fully aware that the con-'ditions of working the forests are dependent on circumstances, 'such as varying demands and variable seasons, which are beyond 'control; but they consider that a careful review of the actuals 'over a number of years might lead to a closer approximation,

'especially in estimating expenditure, than is at present attained.

"3. They are, however, disposed to think that the discrepancy under consideration is often due to a not unnatural desire on 'the part of the Forest Officer to provide for all the expenditure 'that may be required should the year be favourable, and at the 'same time not to commit himself to a higher estimate of receipts 'than will probably be realised should the year be unfavourable. 'This is clearly wrong from a financial point of view, as the estimates of both revenue and expenditure should be based upon one 'common hypothesis. It is desirable to correct this tendency; 'and it appears, moreover, to the Government of India that in a 'quasi-commercial organisation such as the Forest Department, 'greater facilities for the prompt provision of funds to meet charges 'directly productive of revenue would probably develop the utilization of timber and produce, and so materially increase the Forest 'receipts.

"4. The Governor-General in Council is therefore pleased to 'empower Local Governments and Administrations to sanction 'grants for expenditure in the Forest Department, in addition 'to the budget provision, whenever it is anticipated that such 'grants are necessary to earn, and will probably earn, additional 'revenue of a more than equivalent amount. Section 127 of the 'Forest Department Code will therefore be recast as follows:—

"(1) Whenever a proposed additional grant will be more 'than covered, by a corresponding increase of revenue, to earn 'which the grant is required, the Local Government may sanction 'the grant and the corresponding addition to the estimates of 'revenue without previous reference to the Government of India, 'reporting the amounts and the circumstances to the Government 'of India.

"(2) In all other circumstances the previous sanction of the 'Government of India is necessary. It will not be given except 'under very special circumstances, and the necessity for expenditure in excess of the grant already sanctioned must be fully explained and justified in detail. The mere inclusion in the revised 'estimate of particulars of anticipated additional expenditure is not 'sufficient for the purpose of this section.

"(3) Applications for grants clause (2) must be accompanied 'by the re-appropriation statement prescribed in paragraph 2 of 'the resolution of the Government of India in the Department of 'Finance and Commerce, No. 1360-A., dated 21st March, 1895. 'If a re-appropriation within the sanctioned budget grant for 'forest expenditure is not feasible, a re-appropriation should, if 'possible, be proposed from the sanctioned grants under other 'major heads of expenditure controlled by the Local Government."

"5. The orders contained in sections 125 and 127 of the 'Forest Department Code, and in Circular No. 5-F of 21st March 'last, will apply *mutatis mutandis* to applications for additional 'grants submitted by Conservators to Local Governments for sanction under the authority now conveyed."

Forest Revenue, in thousands of Rx.

Provinces	1889-90			1890-91			1891-92			1892-93			1893-94			Total		
	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference
Central Provinces	119	115	— 4	121	121	-	130	136	+ 6	127	123	4	140	113	27	637	608	29
Burma ..	345	494	+149	395	432	+ 37	425	419	6	467	566	+ 99	485	579	+ 94	2,117	2,490	+373
Assam ..	27	38	+ 11	30	33	+ 3	28	24	— 4	35	38	+ 3	37	49	+ 12	167	192	+ 25
Bengal ..	69	77	+ 8	77	73	4	78	79	+ 1	83	75	— 8	78	80	+ 2	385	384	1
N.-W P & Oudh	141	171	+ 30	154	164	× 10	171	178	+ 2	172	165	7	165	171	+ 6	803	844	+ 41
Punjab .	90	92	+ 2	103	83	20	95	102	+ 7	95	81	- 14	90	91	+ 1	473	449	- 24
Madras ..	155	156	+ 3	158	180	+ 22	180	169	— 11	190	158	— 32	190	195	+ 5	871	858	— 13
Bombay ..	301	314	+ 13	344	329	— 15	350	328	22	352	327	— 25	351	379	+ 28	1,698	1,677	21
Total ..	1,245	1,457	+ 212	1,382	1,415	+ 33	1,467	1,440	27	1,521	1,533	+ 12	1,536	1,657	+121	7.151	7,502	+351

Forest Expenditure, in thousands of Rx.

Provinces	1889-90			1890-91			1891-92			1892-93			1893-94			Total		
	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference	Budget	Actuals	Difference
Central Provinces	78	70	— 8	80	73	— 7	92	80	— 12	93	85	— 8	100	92	8	443	400	43
Burma ..	153	160	+ 7	153	139	— 14	174	167	— 7	185	180	5	198	185	— 13	863	831	- 32
Assam ..	24	25	+ 1	26	27	+ 1	29	27	2	33	26	7	31	27	— 4	143	132	— 11
Bengal ..	43	40	— 3	45	41	5	47	42	- 5	48	38	— 10	40	40	8	232	201	31
N.-W. P. & Oudh	88	96	+ 8	96	91	— 5	106	95	— 11	105	92	— 13	100	96	- 4	495	470	— 25
Punjab .	66	64	— 2	80	65	— 15	73	64	— 9	71	66	5	68	64	— 4	358	323	— 35
Madras .	128	115	— 13	128	124	4	134	131	3	161	132	29	183	136	— 26	713	628	— 75
Bombay ..	189	177	— 12	203	186	- 17	203	193	— 10	224	190	— 34	225	206	19	1,044	952	92
Total ..	769	747	— 22	812	746	— 66	858	799	— 59	920	809	—111	922	846	— 86	4,291	3,947	—344

Planting at Naini Tal

The stability and security of Government House at Naini Tal have recently formed the subject for much searching of heart and anxious discussion on the part of Engineers and geologists. We are glad to see that tree-planting is recognised as a factor in the case, for we read in a recent resolution as follows: –

"Intimately connected with the subject of tree-planting and 'covering the slopes with grass and shrubs are those of the prevention of grass-cutting, grazing, and the formation of by-paths across 'the hills as short cuts from one part to another The Municipal 'Committee wisely framed bye-laws dealing with these subjects, and 'directing that the acts referred to should be deemed to be *public* 'nuisances; but unfortunately they have neglected to insist upon 'the observance of these rules and to punish offenders against them. 'The hillsides are again scored with tracks improperly made, and 'grazing on private estates had increased to such an extent that the 'Commissioner in October, 1894, actually suggested the recognition 'of the existing practice and the relaxation of the rules. He was 'requested, in reply to the communication made by him, to see that 'the rules were rigorously and impartially enforced, but with this 'order he has failed to comply. His Honor regrets to observe that 'cases of infringement of the rules came under his personal notice '*during the current season*, rendering it necessary to again insist 'that efficient measures should be taken for the patrol of the hill-'sides and for the detection of offenders.

"The Government is willing to assist the Committee in the 'matter, and will ask the Forest Department to undertake the duty 'of planting the hillsides so far as may be required,—a matter 'which appears to be beyond the power of the local authorities. The 'Conservator of Forests, Central Circle, will be requested to arrange 'for the planting of trees, and, where necessary, of shrubs and grass, 'on the bare slopes within the catchment area of the lake. The 'choice of trees and *of the localities for planting will be left to* the 'Forest Department. The operations will extend, in the interests of 'the settlement at large, both to public and private land; if any 'questions arise with reference to the latter, they should be referred 'through the Commissioner to the Municipal Committee, which has 'power under its bye-laws to take such measures as may be neces-'sary for the safety of the place. The Municipal Committee will 'be expected on their part to effectually close, and to keep closed, 'all superfluous paths on Sher-ka-danda, to prevent all grazing 'and grass-cutting within the prescribed limits, and to fence the 'public roads traversing the bare slopes to the eastern extremity 'of Sher-ka-danda."

India Rubber in Upper Burma

The following report on the rubber tracts in the Minbu District, by Mr. W. F. T. McHarg, Assistant Conservator of Forests, is interesting from the fact that until a couple of years ago it was not known that the *Ficus elastica* was found in such low latitudes in Burmah, and when it was discovered that rubber came from the hills west of *Minbu* it was understood that it was collected from a creeper. It now proves to be the *Ficus elastica*, the specimens which Mr. McHarg sent down having been identified by Dr. King of the Royal Botanic Gardens, Calcutta, to be those of the *F. elastica*

The locality described by Mr. McHarg is just below the 20th parallel of north latitude, east longitude, 94° 36'. So far the tree has not been found between this and the Manipur hills in latitude 24°, longitude 94° 10, though on further exploration of the Chin hills it may be found.

The discovery although interesting botanically is not likely to prove important from a revenue or industrial point of view, as the number of trees is small, and we do not see our way to increase the number by planting at present.

F. B. D.

The road up to the rubber forests starts from Zinbyun close to Dahatgon on the Man. The ascent begins at once on passing Gokwa, and at about the 8th mile from Zinbyun hill evergreen forest is entered at an elevation of about 3,000 feet. The summit of the "Nat-yegan" (Devil's Pool) hill, about 4,000 feet high is reached at roughly the 10th mile. On the top are open grass patches, and during the cold weather a small pool, whence the

Linde, Chin village, is about 4 miles down the other side, situated on the Pani headwaters at an elevation of 2,000 feet.

On the 16th April I marched from Linde to Maton, Chin village, first descending about 1,000 feet to the Pani stream, from whence I made Valuation survey No. 1 up that stream; thence crossed a ridge of about 3,500 feet height, the top of which was quite wet with the morning mist, down to the Maton stream at about 1,000 feet height, and there ascended about 1,000 feet to the village.

On the 17th I made Valuation survey No. II of the rubber trees up the Maton stream.

On the 18th I marched back to Linde, making Valuation survey No. III down the Kyaungtha stream to its junction with the Pani.

West of the "Nat-yegan" hill, with the exception of the ponzôs, practically the whole forest is evergreen. These pônzos (taungya grounds) are found on every spur rising from the streams to about 3,000 feet elevation.

The country being thickly populated they are worked very

heavily, the rotation being often as low as four to five years, all the taungyas cut in any year being lumped together on the same spurs. The people are very careful to make fire-lines all round the burnt area, so as not only to prevent fire spreading into their other pônzos, but also into evergreen forest above. They explain the latter by saying the "nats" would be angry, but possibly may also understand the influence of the evergreen forest on the water-supply.

First, as regards the rubber tree itself, I have little doubt but that the tree found is the true *Ficus elastica*, the same as is found in the forests north-west of Mogaung. These latter I have not visited, but I have seen cultivated trees in the Bhamo district, notably at Shwegu. The tree here found apparently agrees with those, as with the description of the tree given in Kurz's Flora and again in Mr. O'Bryen's report. In this part it is always found near water, the roots forming a regular lace-work over the bank and running down into the bed of the stream. It always starts by the seeds germinating on the top of some high tree and deriving its nourishment from that till it is strong enough to send down aerial roots. Trees which grow on a bank almost always hang over towards the stream; a very great quantity of roots are thus thrown out, and, reaching the ground, grow into so many stems. One of the largest trees seen by me had 38 of these root-stems:—

Over 6 feet girth	6
From 3 to 6 feet girth	12
Under 3 feet girth	20
Total ...	38

The same tree had a girth of 60 feet all round, one diameter being 20 feet and another at right angles to it 16 feet across.

Secondly, as regards the *extent* to which the tree is found, the information I picked up and the number seen by myself would indicate it to be very scarce.

On examining the Lindè, Matôn, and Meinseing thugyis, in whose jurisdiction alone almost all the rubber trees are found, they said that roughly the following number of trees existed:—

		Trees.	
In Lindè	30	20 big. 10 small.
In Matôn	60	20 big. 20 middling. 20 small.
In Meinseing	50	30 big. 20 small.
In other parts, principally Shwehen say	10	10
Total .	150	

The valuation survey made by me gave the following results, and these I would point out were made in the richest localities only :—

Number of live trees.

Name of stream.	Big.	Small.	total.	Dead trees.	Area.	Acreage.
					Chains.	
1. Pani stream	6	2	8	1	4 × 60	24
2. Matôn stream	12	5	17	...	4 × 125	50
3. Kyaungtha stream ..	4	1	5	...	4 × 80	32
Total ..	22	8	30	1	...	106

or 8½ acres to each tree, and that only in the best parts.

The tree is only found in about half-a-dozen valleys as shown on the attached map. I made many inquiries as to whether it occurred west of the Matôn valley on the Arakan side, and was told that the nearest villages on that side were Minbaw and Salutaung, where there were said to be police guards, but that no rubber trees had ever been found in that jurisdiction.

Neither is it said to exist at the headwaters of the Man, but only at those of the Pani and Matôn. I was told, however, both by the thugyis themselves and also by the Ngapè Myoôk, that Lindè, Matôn, and Meinseing and Shwehen all lie within the Minbu district. Of course it is very possible that the three thugyis may not have liked to give a full account of all their trees and that 200 or 300 may be nearer the real number.

Thirdly, regarding the history of the trade and the amount of rubber yielded, the thugyis own to having tapped their trees four different times only.

Ten years ago a Chinaman came up to them from Thayetmyo and showed them how the trees could be tapped to yield rubber, or more probably he was the first to let them know that they could make money by selling the rubber to him. Anyhow the amount reported to have been then yielded is as follows :—

	Trees.	Viss.
Lindè	30	300
Matôn	60	400
Meinseing	50	130
Total ...		830

They state that in this the first year they began by selling to the Chinaman at Rs. 40 per 100 viss rising to Re. 1 per viss.

The year after, *i. e.*, nine years ago :—

	Trees		Viss.
Lindé's	... 30	gave	200
Matôn's	... 60	,,	300
Meinseing's	... 60	,,	70
Total		...	570

This also appears to have been sold to the Chinaman at about Re. 1 per viss, presumably delivered to him at Nyaungnwe as he came up from that side. So that considering the Rangoon prices must have been quite Rs. 3 per viss, that Chinaman must have made a big profit.

After this it is stated that no rubber was tapped for about six or seven years. Probably they gave the trees a rest for one or two years, and do not like to confess having tapped them afterwards in the British time without any license. There *was* one case in which the Tabuywagaung got run in by the Tnayetmyo authorities for tapping rubber. However, the third tapping was done two years ago with the following results :—

	Trees.		Viss.
Lindè's	30	yielded	200
Matôn's	60	,,	300
Meinseing's	50	,,	60
Total		...	560

and the fourth tapping last year :—

	Trees.		Viss.
Lindè's	30	yielding	100
Matôn's	60	,,	150
Meinseing's	50	,,	50
Total		...	300

During these last two years the rubber has been sold to Maung Nida of Minbu and his partner Maung Tha of Zinbyun at Rs. 2 per viss delivered at Zinbyun.

The revenue made from rubber by this division in past years has been as follows :—

Year.		Rs.
1890-91 ...	One license at Rs. 2 ...	2
1891-92 ...	Eight licenses at Rs. 2 ...	16
1892-93 .	Six licenses at Rs. 2 ...	12
	Total ..	30

In anticipation of licenses being issued as in former years a few trees have been tapped this year. Thus :—

	Viss.
Lindè has got about	... 5
Matôn about	.. 60

still stored in the village from this year's tapping.

The Meinseing thugyi explains his small yield of rubber as shown above from the fact that only about two or three of his villages understand the work. Possibly, too, most of his trees are smaller than those of Lindè and Meinseing.

One very satisfactory point is that they all thoroughly understand that a tree cannot be tapped year after year without its yield being greatly diminished, and that excessive tapping in any year will either kill some of the stems or even the whole tree altogether. They quite see that the two first years' tapping was too heavy; then their cuts, as still seen on the scarred stems, were about 1 foot apart, 1 foot long, and probably about 3 to 4 inches wide, so chipping out a piece of the bark and reaching into the wood.

Many stems so tapped dry up and get attacked by insects and die off.

Now, although their cuts are quite as close together, it is done with *one* stroke only slightly bending the bark over, and it is only about 6 inches long or less. I made particular inquiries as to whether the rubber juice oozed out as well from so small a cut and they seemed to think it did.

The big trees are said to have first yielded from 7 to 8 viss per tree, but now only about 4 to 5 viss. The small trees at first about 1 viss, and now little or nothing. The trees are tapped in the cold weather *only* as then the yield is best. There are only a few men who are expert enough in climbing to do the work. They tap the large branches, every aerial root that is large enough to bear a cut, and also all the larger roots that appear above ground. I explained to them that, if tapping were allowed, they would not be able to tap aerial roots of less than 3 feet girth nor below 3 inches height from the ground. The profits are divided amongst the particular men who work the trees and possibly also the thugyi.

Fourthly, as to the plan on which the trees should be worked in future. The usual price at which Burmans buy the rubber from the Chins is Rs 2 per viss delivered at the end of the cart-road. The Rangoon price being Rs. 4 per viss and above, I think there is no reason why we should not levy a duty of 12 annas per viss as at Bhamo and Kindat.

Similarly proper rubber licenses at Rs. 10 should be issued instead of those formerly at Rs. 2.

It is much preferable that *one* man only be allowed in any one year. I would therefore sell one license only by public auction at an upset price of Rs. 10 ; not, however, that I expect that

this will fetch much. It is possible that no man may come forward, seeing the increase in the duty to be paid. This need not concern us as the trees will thereby get a rest.

Since there is still a certain amount of rubber in the Chin villages which they cannot bring out owing to there being no licenses, I would allow the trees to be worked this next cold weather of 1894-95. The year after the trees should have a perfect rest or even a rest of two years as advised by Mr. Mann, Conservator of Forests, Assam.

[NOTE. A Viss=3·6 lbs.]

Siam Gamboge.

The tree yielding Siam Gamboge (*Garcinia Hanburyi*, Hook. f.) is closely related to *G. Morella*, Desrouss, of Ceylon and Southern India. The former is a moderately large tree. The flowers are dicecious, the petals, in both male and female flowers are fleshy and yellow. The fruit is the size of a crab-apple, *yellowish-green* when ripe. The tree is found on islands on the east coast of the Gulf of Siam, as well as on the mainlands of Cambodia and Cochin-China. It is from these localities that practically the whole of the Gamboge of commerce is obtained. Gamboge is a gum resin yielded by the bark of the two species above mentioned. *It is a powerful* cathartic medicine, but its principal use is in a pigment in water-colour painting. It is also used to give colour to lacquer varnish for brass work, etc. The most recent account of Siam Gamboge is contained in a report on the trade of the year 1893, published by the Foreign office (Annual Reports, 1895) No. 1520. Mr. de Bunsen, Her Majesty's *Chargé d'Affaires* at Bangkok, was good enough to communicate to Kew specimens of the leaves of the gamboge trees collected on the spot by Mr. Beckett, and although the material is not quite complete, there is little doubt they belong to *Garcinia Hanburyi*, Hook. f. The extract from the report is as follows:—*Gamboge* is, next to gum-benjamin, perhaps, the most interesting of Siamese products. Whilst gum-benjamin is peculiar to a small belt of land in the north, gamboge is a resinous product indigenous only in the islands and the sea coast of the Gulf of Siam lying between the 10 and 12 degrees of north latitude. * I recently had the *opportunity of paying* a visit to this part of Siam, and it may be of interest to describe the character of the tree and the mode of extracting the resin. The tree is known locally as "Ton Rong." It is found only in the islands of Koh Chang, Koh Kong

* The heavy rainfall of this coast seems necessary to the existance of the tree.

and Koh Rong, and the main land of the Indo-Chinese Peninsula opposite these islands. The trees grow to the height of some 50 feet and are straight-stemmed with no lower branches, owing probably to the dense shade of the forest in which they grow. None of those I saw had a diameter of more than 12 inches. Ten years' growth is said to be required before the tree is ready for tapping. This is carried on by the Cambodian and Siamese islanders in the rainy months from June to October, when sap is vigorous, by cutting a spiral line round the trunk from a height of some 10 feet downwards to the ground. Down these grooves the resin wells out of the bark and trickles in a viscous stream into hollow bamboos placed at the base of the tree, and from these it is decanted into smaller bamboos, where it is left for about one month to solidify. To remove the gamboge the bamboo is placed over a red-hot fire, and the bamboo husk cracking off, there is left the article known as "pipe" gamboge. The trees can be tapped two or three times during one season, and at the end of the season their trunks present a curious network of interesting spirals. Care must be taken to prevent the rain-water mixing with the resin in the grooves, as any mixture of water causes honey-combing and black discolouration, and a consequent depreciation of from 20 to 30 ticals (£2) per picul in value. The most valuable gamboge is that which is the least honey-combed or discoloured, and is all the more difficult to obtain considering the period of heavy rains during which the resin is extracted. The bamboos contain on an average rather less than 1lb. of gamboge or about 170 bamboos to the picul. The price asked by the pickers themselves is at the rate of 2 ticals (3s.) for five bamboos full, and the local price is at the rate of 2 ticals (3s) for three, or 65 ticals (4l. 18s.) per hundred, or about 8l. 7s. per picul. The whole output is sold to local Chinese traders and taken by sailing boat to Bangkok. *(Kew Bulletin, June and July, 1896.)*

"Schlich's Manual of Forestry."

The fourth volume of this thoroughly exhaustive and useful work, entitled *Forest Protection*, comes from the facile pen of that well-known advocate of reafforesting, Professor Fisher. Like the previous parts, the present volume savours much of the foreigner and scientist, and will unquestionably rank high in the forest literature of our Indian dependencies and European countries generally. The chapters on "Protection of the Forest against Animals," "Protection against Atmospheric Influences," and "Injurious Forest Insects" are thoroughly exhaustive and practical, although we could have wished that such insects as have been found dread enemies to many of our British forest trees had received a greater share of attention and remedial measures and been more exhaustively

considered. Hand-picking and shaking may do well enough for a few individual trees, but with an infested forest area such means of combating the pests are utterly expensive and ineffective. Considering how plentiful the goat moth (*Cossus ligniperda*) is in and around London, it might have been useful to many had the most successful known means of destroying the larvæ been given, *viz.*, by filling up the entrance to the tunnels with a preparation of soot and lime, chloride of potassium, or common tar, all of which have been used with telling effect on the trees in the London parks. A thoroughly exhaustive paper is that on "Fixing Shifting Sands," and much good has been done in that way on the coast of France and elsewhere on the Continent—less so in this country, though greatly modified rules to those given by the author have worked wonders on the Norfolk Broads and around the Cambrian coast. "Damage to Trees by Acid Fumes"—a subject that has received but little attention in this country—concludes what will be found, on perusal, to be a valuable volume to the owners of extensive tracts of woodlands, and Professor Fisher is to be congratulated on the appearance of so useful a section of "Schlich's Manual of Forestry."—(*Timber Trades Journal.*)

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The Treatment of Casuarina on Sand-dunes.

Mr. E. McA. Moir's interesting remarks on the treatment of sand-dunes in France in the *Indian Forester* for the month of June, and especially his remarks in connection with the growth of the small pines near the sea-shore though entirely "sheltered from wind" being stunted, as compared with those half a mile distant exposed to the "full force of the western gales," instigate me to record a few notes on the Casuarina under somewhat similar circumstances on the sea-shore near Bulsar in the Surat District.

Efforts have been made to establish the *Casuarina equisitifolia* on the sea-shore at this spot for some time past, and last year I managed to raise at least 25,000 transplants at a nursery established for the purpose in the vicinity. Unfortunately, just about the time when the final planting operations were to take place I was transferred to another Division. But, nevertheless, I gained sufficient experience from the existing plants to justify the presumption that without some special method of treatment it would be impossible to rear the plant successfully. While trees at a distance of half a mile inland on private property were doing well, those on the sea-shore itself were stunted and unhealthy even when fairly well sheltered from the strong sea breeze. I came to precisely the same conclusion as to the cause of this as did Mr. Moir in the case of the pines on the coast of France; but whereas he seems to express some doubt, there is no occasion to entertain any, so far as the Casuarina are concerned. The sand deposit on the minute needles and on the bark and twigs was easily perceptible to the naked eye, and could be rubbed off with the finger. Under a powerful magnifying glass the appearance of the deposit was appalling and quite sufficient to suspend the physiological functions of any plant. These microscopic particles of sand, moreover, appear to travel with considerable force, penetrating the cortical depressions and irregularities and filling up the stomata of the leaf system. The dunes I refer to are partially covered by that valuable creeper the *Ipomœa biloba*, and in treating the Casuarina for this evil two courses seem to be open to us—(1) to greatly add to the quantity of this or any other creeper, a grass that may be induced to grow, thereby reducing

the surface area of sand exposed to the wind, and (2) to occasionally wipe or syringe the plants free of the deposit that forms on them. The second course might, at first sight, strike one as being impracticable, but as the formation of this deposit is very gradual plants need not be subjected to such treatment very often. I cannot help wondering how the Madras Officers have got over this difficulty, for surely they cannot have been free of it, and I think it would be of considerable interest if one of them were to give us his experience in the *Indian Forester*.

GODHRA,
Panchmahals.

W. A. WALLINGER.

[NOTE.—So far as our experience goes, the difficulty has not occurred in the Nellore plantations.—HON ED.]

The Shifting Sands of Gascony: an Historical error.

In Number 13 of the "*Revue des Eaux et Forêts*," dated 10th July, there is an interesting article on the true history of the celebrated work of fixing the moving sands of Gascony. It has generally been supposed, and the various text books from Bigneris to Boppe have lent their support to this idea, that the credit of this great enterprise is due to an engineer who lived at the end of last century, Nicolas Thomas Brémontier. It appears, however, that this is not quite the case.

In 1734 Alain de Rust planted or sowed pines and oaks on the sandy dunes near Buch, and the work was continued by his grandson in 1779. Incendiary fires, however, destroyed the plants that came up, and the sowing was not successful.

During the latter half of the eighteenth century the onward progress of these moving sands attracted universal attention, and means for arresting them were sought for. The chief idea at this time was not so much to fix the sands as to make canals to lead off the superfluous water and to turn the waste into culturable land.

This was the leading idea in a petition presented to the King by the Comte de Montausier in 1773, but the scheme came to nothing because the Public Works Department of that day declared that it was absolutely impossible to fix the moving sand hills, and, be it remarked, it was the sub-engineer, Brémontier, who first gave utterance to this unfavourable opinion. Numerous projects for rendering the dunes culturable by draining off the water were then set on foot, but they all collapsed because their authors had neglected the one primary condition of success. Among these were two brothers, named Desbiey, who were interested in protecting their own property by sowing pine seed, and one of whom wrote a paper on the subject which was rewarded by the Bordeaux Academy of Science and printed in 1776.

In 1778 an engineer, named Baron de Villers, was sent by *Louis XVI to study the question of the dunes generally*, and more especially the formation of a harbour in the bay of Arcachon. De Villers remained four years and wrote several able reports on the subject, in one of which he clearly laid down the axiom that in order to prevent the onward march of the sand, it would be necessary to sow pine seed; and to make this a success it would be essential to fix the seed on the ground by some means or other, and thus prevent its being blown away or buried in sand. He also recommended sowing the very seeds which are used at the present day, and which are quite at home in *pine sand; and he gave his reasons for the proposal.* In conclusion, he solicited that a trial of his system should be made for two years. The Government of that day listened to his request, and in 1784 sent Brémontier to carry out this work. Since the days of Montausier his opinions had changed, chiefly owing to the reports of De Villers, and he set to work at la Teste, aided by a land-owner, named Peychon.

Peychon had previously made several successful attempts in sowing the sand-hills, and covered his seed with branches to prevent its being blown away. Whether he discovered this process *for himself, or got the idea from De Villers, or from the works of* General Claussen in Zealand is not known; anyhow he was the man Brémontier wanted, and he was attached to the enterpise as inspector of works. They commenced their labours in 1787, but Brémontier refused to employ a covering of branches, contrary to the advice of Peychon; the wind swept away all the seed, and the work was stopped not to be resumed again, owing to the troublous times, till 1802, when the colossal enterprise of fixing 3,00,000 acres of the sands of Gascony really commenced.

During these years of inaction numerous pamphlets appeared shewing the feasibility of re-wooding the dunes, and the *advantages* that would ensue to the country all around, and to the State itself. The most important of these brochures was one by Brémontier himself, in which he utterly ignored the previous suggestion of Rust, the Desbieys, and De Villers. However, he is not the only man who has endeavoured, with more or less success, to take to himself unjustly all the honour and glory of a grand undertaking, and though it is clear that he did not originate the system, there is still due to him the honour of having, by practice and by precept, convinced the world that the work was feasible, and of having satisfied the Government, so that funds were forthcoming. But the credit that is due to Brémontier is over-shadowed by the manner in which he entirely ignored the writing of his predecessors even while quoting their figures, and by giving no credit to the discovery of Peychon, who died without being able to show what share he had taken in the work. The honour was, however, justly apportioned by the Conservator of Forests at Bordeaux in 1812 in a report addressed to the Commission of the Dunes.

A. S.

Influence of the Season of felling on the production of Stool-shoots in the Oak.

(According to MM Bartet and Hartig).

Hartig's investigations appear to have been the first made in Germany on this subject; at any rate the author concludes his article by saying, that it would be desirable to make similar experiments with a simple coppice or coppice with standards with a view to determine the results of a felling out of season on the shoot-producing capacity and on the vigour of the shoots produced. He evidently ignores the fact that this question has already been studied in France by M. Bartet with that scrupulous exactitude and thoroughness which characterizes all his work.

Although much less complete than the observations made at their experimental station of the Ecole forestière, as they only refer to one species, the oak, represented by a single type of stems, the results obtained by the celebrated Munich professor are deserving of notice in these pages for several reasons. The experiments made at Nancy were restricted to the stumps and reserves of different ages in a coppice with standards as was naturally indicated, since it is chiefly this method of treatment, depending as it does on the aptitude of our leafy species to produce stool-shoots, which is likely to benefit by the results of these experiments. The Munich experiments were only made in a high forest crop in the absence of any coppice in the neighbourhood of the town, for the rest the author's principal object in felling trees every fifteen days from the 2nd May to the 6th December was the study not of the production of stool-shoots, but other physiological points, such as the movement of the reserve material, the duration of the formation of wood, &c. The trees experimented on at the two stations differ not only in their origin, but the conditions of soil and climate in which they were grown differ, and, as M. Bartet justly observes, these two factors are most important in a matter of this kind. It will be interesting to notice the extent of their influence.

The following is a *resumé* of the results obtained by Dr. Hartig:—

The trees were chosen in a high forest crop which was thinned some years previously, and were 50 to 60 years old, with an average diameter of 0·14 m. at breast height. They were cut with the saw 0·07 m. above the ground, the usual precautions being taken to guide the fall of the tree and avoid jamming the saw. In the same year (1893) numerous shoots were produced on the stools of the stems felled on the 2nd and 17th May, the *6th and 21st June and the 4th July. The shoots attained* a height, on the first two series of stumps, of about 0·30 m., on the two next 0 20 m. and on the last 0·10 m.

The stools cut on the 29th July produced well formed buds in the autumn but no shoots. As to those of the 5th and 19th and 30th September and the 6th December they remained inert during the year.

In the spring of 1894 the shoots of the first three series had not suffered during the winter, but those of the stools of the 21st June and 4th July had been frozen down to the base.

In September 1894 the shoots of the first five series of stools (*i.e.*, from 2nd May to 4th July, 1893) were about one metre in height, just the same as those of the two last series (30th September and 6th December) which had been formed during the year The shoots from the fellings of 20th July and 19th August were smaller, about 0·07 m. high, and none were formed at all in the stools of the 5th August and 5th September.

From this Hartig concludes that it is only on the stools of trees felled up to the middle of June that shoots sufficiently developed to resist the frost are produced. From the middle of June to the middle of July the stools produce shoots in the same year, but their tops are frozen in the winter. Stools cut later than this either remain unproductive or furnish shoots in the following year only.

If these results are compared with those published four years previously by M. Bartet, a striking similarity will be noticed in spite of the important differences already referred to in the character of the experiments. The oaks of the high forest of Spessart grown on a deep, fresh soil from the variegated sandstone at a greater elevation and in a colder climate than that of Nancy have behaved in a very similar manner to the oaks of the Haye coppice grown in a shallow dry limestone soil of the Lower Oolite.

While the stools of the oaks cut on the 20th July at Munich produced no shoots in the same year, about four-fifth of those cut at Nancy on the same date did give shoots, and about half of the shoots of the 15th August were still productive. It was only the stools cut at the end of August that produced nothing. At Munich this result would be obtained at least a month earlier. To legitimately attribute this difference to the factors of soil and climate, however, the experiments on the two places should have been made the same year with identically similar trees, which was not the case, since the Nancy experiment was made with stems of 35, 60 and 85 years old, cut as close to the ground as possible from a coppice with standards crop; whereas the Munich experiments, as we have just seen, were made under totally different conditions, so that it is impossible to state with certainty the cause of the difference noted. As regards atmospheric influence the shoots behaved in very much the same way in both places. Hartig states that those which arose from the stools cut on the 21st June and 4th July were frozen down to the base in the next

spring. It was in these two months also, according to M. Bartet, that the percentage of stools rendered unproductive by the total loss of their shoots reached its maximum (11 %), and from observations made on the ground it appears that the oak shoots were killed by early autumn frosts.

As regards the height of the shoots, too, both obtained the same results, *viz.*, an average height of about one metre for the dominant shoots of two years' growth from the stools cut May to July; and in both places a noticeable diminution took place in those of about the middle of August, again a considerable increase from the end of that month. Instead of an average height of 0·59 m. for the dominant shoots of two years on the stools cut on the 15th August, one metre was measured at Nancy for the fellings of the end of August, and 1·05 m. for those of 15th September and at Munich one metre for fellings of 30th September and 6th December. These shoots produced during the year are therefore about the same height as those of two years growth, a fact attributed by M. Bartet to the following causes. First, the influence of early frosts on the young imperfectly matured shoots; secondly, the variation in the quantity of food materials contained in the shoots (including root system) at the different periods of vegetation. Whether one takes into consideration the shoots produced during the year of felling, or those which date from the following spring, it is noticeable that the advantage lies with the areas exploited *from end of August* to middle of September (or later presumably) from which there is a justifiable presumption that the stools in these areas supply more abundant nutriment to the shoots than the others do. And judging from the height of the dominant shoots, it is during the first half of August that the stools of the oak are most deficient in food material.

I am inclined to ascribe greater preponderance to the second cause because in both localities the shoots arising from fellings of 15th March, 15th April, and 2nd May, which were sufficiently well matured not to suffer from frost, did not attain a greater height in two years than the one year shoots from the stools of the last four months of the year.

This comparison appears to demonstrate the existence of a physiological law which preponderates over external influences, *and that the conclusions to be drawn from M. Bartet's experiments* remain true for trees grown under other conditions of vegetation. In any case it would be a good thing to have the results of similar observations made in the oak coppices of the south of France to completely elucidate this question which is one of undeniable interest, whether it refers to a coppice, a high forest, or a coppice undergoing conversion. (By E. Henry in the *Revue des Eaux and Forêts*).

A. F. G.

The Teak Trade in Siam.

An interesting report on the teak trade of Siam is published as No. 357 of the Miscellaneous Foreign Office series from Her Majesty's representative at Bangkok.

The teak bearing forests of Siam lie in the north, and the most productive region at present may be included in a circle which, drawn round Chiengmai and Phree, encompasses all the head waters of the Me-Ping, Me-Wang (Lakon River) and Me-Yom. The right bank of the Me-Ping from the Me-Layan, down to Klong-Kong below Kampeng, is also a very productive district. Both sides of the range of hills here are scattered over with teak forests; the timber on the west side being floated down the streams to the Thoungyengh, and thence into the Salween, and that on the eastside into the Me-Ping, and finally to Bangkok. The nearest teak forest to Bangkok is situated on the head waters of the Mewong (Sa Kay Krang River). The majority of the posts and small timber used in local consumption comes from the Nam Pat above Utaradit. A quantity of teak is derived from Naw, but no reliable statistics are as yet forthcoming in regard to this district.

The report is accompanied by an excellent sketch map showing the tracts already worked, and those reported as bearing teak but not yet worked. They lie roughly between latitude 11 degree and 20 degree N.

The logs are brought down in rafts which are arranged in tiers or rows, and the logs are fastened together by stout rattan ropes, fastened to holes cut in the ends of the logs. On the Me-Ping the rafts contain, on an average, 150 logs, whereas the Sawankaloke rafts are smaller, averaging only 130 logs. The Me-Ping rafts have generally 10 logs in the first tier, which increases in the other tiers to 16, and then tapers off to 10 again at the end. An outside row of logs serves as a fender, which can be cut adrift when the logs collides with the bank, or when there is danger of stranding at the side. This preserves the whole raft from being broken up. The Sawankaloke rafts are longer and narrower,

beginning with a tier of 6 logs and increasing to 10. For a fender the outside rows slide endways into each other, and the whole raft is looser in arrangement than on the other river. The different character of the streams account for the difference in arrangement of the rafts. The Me-Ping is broad and shallow ; the Me-Yom is deep, narrow and tortuous.

The Sawankaloke rafts are fitted up with three large paddles as steering gear, but on the Me-Ping the rafters have to remain in the water the whole day to steer the raft. Their gear consists of two stout rattan ropes, 40 fathoms long perhaps, each fastened to a bamboo stake. To move the raft right or left one rafter sticks his bamboo stake into the soft sandy bottom and hangs on to it up to his neck in water till the proper adjustment of the course takes place. Steering gear by means of paddles is put on at Paknampoh. A raft takes 10 or 15 days to come down from Raheng to Paknampoh, and during that time the rafters are practically in the water the whole day. In another three or four days the raft reaches Cheinat, the duty station, where the up-country rafters stop and return. There are usually three rafters on a raft, and they get 7 salungs (2*s*) a log from Raheng to Cheinat. From Cheinat to Bangkok, covered in from eight to ten days, rafting costs another 2 salungs a log. A raft comes down from Sawankaloke to Paknampoh in about ten days, and the rates for rafters are about the same as on the other river.

The rafting season begins in June with the rising water, and timber floats down plentifully in July and August. For sometime after that date the rush of water is too violent to float rafts in safety, and sometimes the water is so high that the beds of the streams are unrecognisable.

There is danger then that a whole raft may float out into the rice fields, where it will remain stranded high and dry, an easy prey for timber thieves. In October, November and December, when the water is subsiding again, the greater portion of the timber is floated down.

A large quantity of timber is stolen every year, and the British merchants are anxious to have some regulations issued by proper authority to check this ; and there is an enormous loss to the revenue and the country in general by the indiscriminate destruction of valuable young trees. It is estimated that Siam loses every year in this manner a sum which may amount to £1,50,000.

Pruning Epicormic Branches of Oak.

The "Révue des Eaux et Forêts" of 10th September has interesting article on the above subject, by M. D'Arbois de Jubainville of which the essential part is translated below. One is rather apt to become hide-bound in one's Sylvicultural ideas and it is therefore, in my opinion, particularly advisable to give publicity to new theories, if, as in the present instance, their authors can bring practical evidence in support. H.-H.

"When M. Boppe, the Director of the Forest School (of 'Nancy) lately brought the students to see the Forest of Ligny 'l'Abbaye (Ardennes), which is worked in coppice under standards, 'he remarked that the *epicormic branches* of the oak standards 'were not pruned, and asked us the reason. We answered that we 'had cut up numerous pruned oaks in the sixth, seventh, ninth, and 'twenty-fourth Forest Circles when stationed there; that we had 'invariably remarked that this pruning was more harmful than 'useful; that we had never found pruned oaks preferred by timber 'merchants; and finally that as regards the oaks of this particular 'forest, it had been very generally noticed that the omission of 'pruning did not cause the death of the trees or of their crowns.

'The Director asked us to further study this important 'question, and the Government Forest of Clampenoux (Meurthe 'and Moselle) was chosen for this purpose, because the oak stan-'dards there had been pruned for many years. MM. Henry and 'Hüffel, Inspectors of Forests and Professors at the Forest School, 'took us there on the 16th August last. The oaks here had been 'pruned one year after the exploitation of the coupes, and again 'several times, at intervals of five years, so that the epicor-'mic branches were one year old at the first pruning, and 'five years old afterwards. We felled and cut up some oaks that 'had been thus treated. The lopping of the branchlets one year 'old had done no harm; but the pruning of the five year old 'shoots had been harmful to an extent about ten times as great as 'in the case of similar shoots which had died off naturally, for we 'examined these at the same time.

'The wounds resulting from the removal of the epicormic branches of five years old had become covered over in about two 'years; but the result had been that the wood had become dead for 'a length of from one to three decimetres and a thickness which at 'centre attained one centimetre. This mortification had spread 'above and below the wounds, and was accompanied by a separa- 'tion in the layers of the wood reaching one-third of the lengtho 'the dead tissues. *The instrument must have killed the cambium* 'all round the edge of the section; and thereafter the air and 'rain water had entered at the hole in the bark, vitiated the sap, 'and marked and killed the tissues of the sapwood. The damage 'would have been very much worse had the branches been in 'bunches (a very common case), and the wound would have been connected and formed one large one. If, then, as one 'often sees, fungus had attacked the place, the result would have 'been even more disastrous.

'On the other hand *the defects arising from the natural dying* 'off of this same sort of branch come, as a rule, to nothing more 'than the growing over of a very small piece of dead wood which 'is enclosed within the tree, and has not affected or separated the 'surrounding layers of the wood. When a small branch of oak 'dies naturally, it resists for several years at the point at which it 'is inserted in the bole. During this period the dead part is 'decomposed by saprophytic fungi, and this is brought about 'quickly if there is no heartwood in the little branch. At the same 'time the tree surrounds *the base of the dead branch with a lump*, 'so as to protect it and cover it over as the decomposition goes on, 'in such a way that this lump appears to strangle and to gradually 'amputate the dead branch. This is the natural pruning of the 'oak."

"NOTE.- This natural pruning prevents any degradation of the trees when 'the Standards are numerous in the coppice coupe. The boles being in this 'case sha.ed by the neighbouring crowns, the *epicormic branches* grow less 'vigorously and soon disappear Consequently pruning is unnecessary in a well 'marked coupe, and the trouble and expense of it are done away with."

Is the Lantana a Friend or an Enemy ?

We have received from the Inspector-General of Forests some correspondence on the question of how to get rid of the Lantana in places where, as in Berar, it is making itself a nuisance.

The plant referred to is an American plant with orange-yellow flowers, very prickly rambling stems and a blackish fruit which birds are fond of and which we have seen being eaten by children in the Nilgiris. Its scientific name is *Lantana Camara*, Linn. The Indian indigenous Lantanas are pretty shrubs of a much less aggressive character.

Most of our readers will have come across the Lantana at some time or other, for it may be seen almost anywhere in the Indian plains, but it is chiefly in the South-West, along the Western Ghats in such regions as Coorg and the Wynaad, that it is so troublesome.

The question of whether, after all, it may not, in some cases, be useful in improving the soil and in protecting tree growth from cattle, is one which has now and again been discussed. Dr. Watt, in his Dictionary, quotes Mr. R. H. Thompson as writing in our pages (Vol. VI.) and considering it highly useful in tracts which have been disforested. Mr. Hill writes to us on the subject as follows :—

"It is evident that the *Lantana* grows densely and has great 'vitality and often spreads over large areas, effectually preventing 'the growth of grass. On cultivable and pasture lands, as well 'as on lands where grass is grown and harvested and where tree-'growth is at best a secondary aim, there would seem to be no 'doubt that the shrub is an evil, and should be eradicated as is 'being done in the neighbourhood of Chikalda and elsewhere.

'The correspondence, however, is by no means convincing as 'regards the utility or otherwise of this plant in forest areas where 'the object is solely to obtain a dense growth of trees and bamboos 'and to complete the canopy. In such cases, it seems quite 'possible that the spread of *Lantana* over blanks and open places 'may materially aid in attaining the object in view. *Lantana*, as 'stated by Mr. Thompson, is a light-loving plant, and is, therefore, 'only found in places where the canopy is incomplete. Under 'these circumstances, as it is admitted that the plant is a free 'grower and a wonderful soil improver, it may be inferred that 'it may well serve, under these conditions, as an auxiliary to the 'growth of valuable species whose self-sown seedlings may spring 'up under its shelter on the improved surface-soil. There would, 'doubtless, be conditions, under which, the seedling being estab-'lished, it would be desirable to weed out the *Lantana* to enable 'these to overtop it or pierce its cover ; but when once tree growth 'had assumed the lead, it is probable that the light-loving *Lantana* 'would gradually die out under the cover of the young trees and 'thus disappear from the forests as blanks became filled up.

'It is hoped that your correspondents who have had expe-'rience of the effects of *Lantana* on the spread of natural repro-'duction in open or incomplete forests, will communicate their 'observations and conclusions."

In reviewing the Berar Forest Report for 1893-94, the Government of India had drawn attention to the difference between the opinion expressed by the Conservator in Berar and that which Mr. Prevost had given, writing from Coorg. They said :—

"The conclusions of the Conservator in paragraph 24 of the 'report that *Lantana* threatens the existence of the forests, are

'noticed to be strangely at variance wit the observations of 'Mr. Prevost, the Deputy Conservator in Coorg, where the same 'shrub is said to materially aid the reproduction of trees and not-'ably that of sandal. Its effect on forest growth in Berar should, 'in the opinion of the Government of India, be further studied 'before any large expenditure is incurred on its extermination 'within forest tracts."

On receipt of this, an enquiry was set on foot in Berar, and the Conservator finally submitted the following report :—

"I have the honor to report as follows on the question of the 'growth of *Lantana*. It seems best to deal with the question first 'generally, and then to note on *Lantana* in Berar and specially in 'State Forests of the better class."

"Opinions undoubtedly differ as to the effect of growing the 'exotic species of *Lantana*, as may be seen from the 'Suggestions of 'the Inspector-General of Forests (Mr. Hill) for the administration 'of the forests in Coorg,' which give notes bearing directly or in-'directly on *Lantana* growth in Coorg, and which were made in '1890 during a tour, when he was accompanied by Mr. Dickinson, 'who had been in charge of Coorg for twelve years, and Mr. 'McKee, his successor in the charge. In this note, while noticing 'the way sandal grows in *Lantana* hedgerows (a fact to which Mr. 'Prevost is probably referring in his 1893-94 report), he does not 'describe *Lantana* as an assistant to reafforestment, which should 'be encouraged, but rather as a growth having certain good and 'certain bad qualities. From the enclosure it will be seen that 'Mr. Dickinson in January 1892 wrote strongly condemning '*Lantana* and advising its destruction—a work which he started in 'a small area the same year, and proposed extending in later years.

"Mr. Prevost, who was seven years in charge of the Melghat 'forests, was in 1893 consulted as to the extension of these *Lantana* 'destruction experiments, when he wrote :—

"I certainly think the experiment worth a trial, and the 'Chikalda plateau can, and in my opinion, *certainly* ought to be 'cleared."

"To the above he added a rough estimate of the cost, which 'ultimately proved over the mark. Writing later from Coorg, 'he said :—"The *Lantana* here is *too* awful ; it costs Rs. 30 per 'acre for clearing the first year, and Rs. 10 per acre the second, 'and then only a few rupees annually. Hundreds of coffee estates 'have been abandoned owing to the *Lantana*."

"Mr. McKee, Conservator of Forests, Southern Circle, 'Central Provinces, writes strongly against *Lantana*.

'On the other side of the question we have the facts 'that *Lantana* is a free grower, a wonderful soil improver, and 'that where, as in hedgerows, it has loosened and enriched the soil, 'and where, owing to clipping, &c, it is kept within bounds, it was 'an admirable nurse in Chikalda to mango, jaman, tún, nim, and

'other trees sown beneath its shelter, while in Coorg in hedgerows 'and isolated roadside shrubs it has proved similarly beneficial.

"Lastly, where *Lantana* grows, grazing is absolutely stopped 'and the growth of grass and shrubs destroyed, while the high 'cost of clearance practically stops the extension of cultivation in 'forest tracts save by the wealthy.

'Finally, there is the assumption (for it cannot be allowed to 'be a fact in all or even many localities) by as great and generally 'accepted an authority as Mr. R. H. Thompson, Conservator of 'Forests, Northern Circle, Central Provinces, who writes:—"In the 'event of the land (*i. e.*, which is more or less covered with '*Lantana*) again coming under forest, the light-loving *Lantana* 'quickly dies out.

'Another question, however, arises here as to the probability 'and the cost of ensuring areas covered with *Lantana* "again coming 'under forest." In the most thickly *Lantana*-covered areas, near 'Chikalda, there were dense masses of this climbing shrub attain- 'ing a height of 30 to 35 feet, and showing no signs of allowing 'forest growth to top and kill it out.

'*Turning now to Lantana in Berar, we find that it flourishes* 'on the plateau and in the ravines of Chikalda with an elevation 'of 2,500 to 3,500 feet, and grows with equal luxuriance in the 'nullahs and waste lands near Ellichpur at an elevation of 1,200 'to 1,500 feet, while it was spreading (thanks to hedges planted on 'the road sides) into the large reserves of the Melghat to which 'we look for a large part of our timber and bamboo supply.

'The position of *Lantana* in Berar is therefore not generally 'similar to that of Coorg, where it only grows in the higher and 'drier forests, whereas in Berar it threatens alike the high and low 'grazing lands, the areas in the Melghat where cultivation should 'spread, *and, above all, it affects the water-supply injuriously*, as 'has been proved by successive analyses of water taken when a 'collecting basin was covered with *Lantana* and at different periods 'after clearance. Finally, though this is not a forest matter, the 'shrub when it grows in masses near villages tends to insanitary 'conditions.

"It is apparent that *Lantana* in Berar threatens the general 'well-being of the country alike, near towns and villages, as well as 'in the most remote forest tracts set aside for grazing and the 'extension of cultivation by aboriginal tribes, and that it is not 'possible to limit our attention to the effect of the growth in the 'timber and bamboo forests.

'It is obvious that *Lantana* cannot be watched from a sylvicul- 'tural point of view in some State forests, and at the same time be 'made the object of extirpation in some others and in the uncultiv- 'vated areas near towns and villages. The work of practical extir- 'pation is one that must be taken in hand thoroughly and at once 'if success is to be possible. A few years of neglect will put

'Berar in the position of Coorg, where extirpation is impossible at 'any reasonable or possible cost.

'It may be well here to note the line adopted in dealing with '*Lantana*. The growth started in the hedges in Chikalda and on 'many miles of the roads to that place, and it was similarly started 'in Ellichpur and a few other towns in Berar.

'Work has been started by a clearing at all outlying places 'and as much as possible bringing the growth within a ring fence 'gradually to be contracted; while simultaneously the most dense 'growth was attacked at the centre, and such clearance carried 'outward.

'The result of the operations has been that the limited growth 'in hedges, &c., planted in three districts, has been quite cleared. 'In two districts where the area was more extensive, a first 'clearance has been made, and the second year's cleaning has taken 'place, so that another year are two should record extirpation. 'In Chikalda and Ellichpur and in Ellichpur district every hedge 'has been grubbed; and a large area of the densest growth has 'been cleared, and had a first cleaning; while nearly all outlying 'plots of *Lantana* in the Melghat north-east and west of Chikalda 'have been cleared once, and are now being cleaned. The growth 'in and near Ellichpur cantonment and town has recently been 'taken in hand, and progress in clearing it should be made this 'year.

'As to the cost, it has proved much below that of experi-'mental areas or of figures obtained from Coorg, the densest areas 'costing Rs. 15-8-0 an acre, while the first cleaning where the growth was heavy, has been Rs. 1-2-0 an acre the first year, and 2 'annas or 3 annas the second year.

'It is hoped that if the work is pushed with energy by all, the close of 1896 will see *Lantana* in Berar mastered, and that 'steady work for a few years will see *Lantana Camara* an uncom-'mon botanical species in Berar.

"In conclusion, I cannot conceive that we should be right in 'trying experiments as to the regenerating effects of *Lantana* in 'our forests when it is at best only probable that it will ultimately 'and at a moderate cost give way to more valuable growth. The 'fact that protection from grazing and fire has already done so 'much, and promises to do so much more, appears to me a further 'reason for not experimenting with an exotic plant that, even if 'it may possibly do good to forest growth, is certain to do harm 'elsewhere."

Appended to this report is the following extract from Mr. Hill's Coorg suggestions to which he had referred.

"The whole of the undergrowth, including trees with low 'cover and *Lantana*, should be thoroughly cleared off the ground and 'burnt. The area to be treated should not be clean-felled, but as 'many trees with elevated cover as are conveniently situated, where

'they can be isolated, should be carefully kept. It may be objected that on several occasions this has been tried and failed, the plants having died off from excessive moisture. The failure, it is thought, was not so much due to the trees left standing as to the weeds and undergrowth not being regularly kept down around the young plants during the rainy season, when their injurious effect would be *increased by overhead shade. Partial clearings of* the undergrowth or *Lantana*, so as to imitate the conditions under which sandal plants spring up naturally by the sides of roads and in hedgerows, would at first sight appear sufficient; but experience goes to show that undergrowth and *Lantana*, especially when so treated, grow with such luxuriance that they become uncontrollable and render the young sandal weedy, and eventually smother them. Under the circumstances, it seems imperative to make a thorough clearing, and in this way give the sandal plants a year's start."

Besides the above, he also quoted Mr. F. B. Dickinson as urging that *Lantana* "should be improved off the face of the earth 'altogether' even as hedges, for the birds eat the seeds and distribute thereby *plants all over the country*"; and Mr. *McKee* as saying :—

"The plant is an old friend, or rather enemy, of mine, for it was a source of much trouble in many of the forest reserves of Coorg, where it was rapidly covering the ground rendering all chance of teak, or indeed any other kind of tree, reproduction impossible, ruining the grazing, and by its inflammable nature increasing the difficulty of fire protection. It was brought to Coorg some 30 years ago in a flower pot by a missionary and then used as a hedge plant, for which it is well suited if kept under strict discipline and constantly trimmed with shears. But it soon advanced from the hedges to the fields and hill sides, and is now so fully established in the province of Coorg that it would be quite impossible, even by spending lakhs of rupees, to eradicate it."

In forwarding the paper to the Government of India, the Resident, Colonel Kenneth Mackenzie, expressed himself as considering it to be a pest which certainly ought to be kept off grazing lands.

Manufacture of Camphor in Formosa.

On the hillsides are built distilleries consisting of oblong-shaped structures principally of mud bricks, and about ten or twelve feet long, six feet broad and four high. On each side are five to ten fire holes about a foot apart and the same distance above the ground. On each fire hole is placed an earthen pot full of water, and above it a cylindrical tube, about a foot in diameter and two feet high, passes up through the structure and appears above it. The tube is capped by a large inverted jar, with a packing of damp hemp between the jar and cylinder to prevent the escape of steam. The cylinder is filled with chips of wood about the size of the little finger, which rest on a perforated lid covering the jar of water, so that when the steam rises it passes up to the inverted jar, or condenser, absorbing certain resinous matter from the wood on its way, Whilst distillation is going on, an essential oil is produced, and is found mixed with the water on the inside of the jar. When the jar is removed the beady drops solidify, crystallization commenses, and camphor in a rude form, looking like newly formed snow, is detached by the hand, placed in baskets lined with plantain leaves, and hurried off to the nearest border town for sale. (Extract from an article in the "Scottish Geographical Magazine" for November, 1895, by John Dodd, on 'Formosa').

Planting Shifting Sands of the Sea-Coast.

We had an opportunity lately of seeing a most successful and interesting undertaking in the way of reclaiming by tree and shrub planting a large extent of sandy land on the Welsh sea-coast. Not many years ago the land in question was valueless, the ever-shifting sands preventing almost every form of vegetation from gaining a footing, and the appearance of the now verdant woodlands was at that time an ocean of loose blowing sands. The first preliminary towards reclamation was erecting a temporary furze fence a little inwards from high-water mark, the fence simply consisting of rough poles put in at ten yards apart, and to which two wires were affixed, the whole being closely thatched with furze, which, fortunately, was abundant in the neighbourhood. This has acted

as an excellent wind-guard, the saline-laden blast being wonderfully sifted and ameliorated in its passage through the finely twigged fence. Behind this storm barrier, pits were opened in the sand at 6 ft. apart, and a quantity of loam and road scrapings placed in each. The trees used were the sycamore, willow, Austrian, Corsican, and Scotch pines, and a few alder, elder, and elms. Between each of these, small patches of the sand soil were prepared and sown with gorse and broom seeds, also with a plentiful supply of birch, which on an adjoining height was found to be growing luxuriantly. This formed the outer boundary; inwards from that, many other kinds of trees being planted, and amongst shrubs we noticed that the sea buckthorn (*Hippophae rhamnoides*) was growing everywhere luxuriantly, it being a shrub above, perhaps, any other that is peculiarly suitable for withstanding the ozone-laden atmosphere of the seaside. The results that have been brought about in eight years would hardly be credited, and clearly demonstrate that the undertaking was wisely and carefully carried out.—(*Timber Trades Journal.*)

Holigarna and its Blistering Principles.

All observant forest officers in India have noticed at different times the remarkably caustic nature of the black secretion that exudes in the dry weather from various species of *Holigarna*. The tree is called in Malabar the black varnish tree, in contradistinction to the yellow-varnish tree or *Garcinia*, which yields the gum-resin known as gamboge. The black varnish is used for waterproofing boats, furniture, and houses, and for indelibly fixing black figured patterns on linen and cotton cloths. There are other natural black varnishes obtained from anacardiaceous trees growing in Burma, China, Japan, and Ceylon, and the exact character of their exudations would form the subject of an interesting research, but the present article endeavours to show the nature of the vesicating principle separated from an hitherto unexamined Indian genus.

Alluding to *Holigarna longifolia*, Roxb., Colonel Beddome describes it as a common tree about the Western Ghauts of the Madras Presidency, from Canara to Cape Comorin, which yields a very black, acrid juice from the trunk and rind of the fruit. This is used by painters as a varnish. Mr. Gamble, in describing this large tree, says, "It gives a black acrid exudation, which raises blisters and is much dreaded by the hill people." Mr. Bourdillon, Conservator of Forests for Travancore, says of it, "The whole tree, leaves, bark, and fruit, secrete a very poisonous black juice, which raises blisters when it falls on the body. It affects some people and not others." The fruit is referred to by

some writers as a medicinal agent, but its action and the uses for which it is employed, are not stated.

There are seven known species of *Holigarna*, all of which are Indian. Their names and geographical distribution are thus recorded in the 'Flora of British India.'

H. Arnottiana, Hook., Western Peninsula.
H. ferruginea, Marchand. W. Peninsula, Travancore.
H. longifolia, Roxb, Chittagong, Pegu.
H. Helferi, Hook., Tenasserim.
H. Grahamii, Hook, Western Peninsula.
H. Beddomei, Hook., Western Peninsula.
H. albicans, Hook., Pegu, Martaban.

The native names applied to these trees are charei. karun-charei, cattu-tsjeru (*Malyalum*); kalu-geri, kuti-geri, hool-geri (*Canarese*); bibu (*Mahratta*). Mr. Bourdillon forwarded some specimens of the fruits of *Holigarna ferruginea* for examination. The exudation from the stem has blistering properties, but this can only be obtained in the dry weather about March and April.

The fruit is a drupe, ovoid or elliptic in shape, black coloured, about seven-eights of an inch long by half an inch in diameter. The pulpy pericarp becomes thin when dry, and is of a uniform black colour, but the pulp when fresh is greenish and mucilaginous. The testa is thin and dark-brown, and encloses a whitish starchy pair of planoconvex cotyledons, with dark coloured veins running through them. The embryo is suspended from below the apex of the fruit, and the minute radicle is situated next to the hilum.

The aqueous soluble extract of the pericarps consisted of mucilage, with a small quantity of a tannic acid giving a green colour with ferric chloride. The ether and alcohol extracts of the pericarp contained the active vesicating principle of the fruit, associated with the black resinous substance forming the varnish. This principle was separated from the resins by adopting the process devised by Stadeler in examining the acrid principle of the cashew fruit. An ethereal tincture was made of the bruised pericarps, and the ether was allowed to evaporate without heat. The residue was dissolved in alcohol and treated with some freshly precipitated oxide of lead. The grey precipitate was collected on a filter, and after washing was digested in some ammonium sulphide solution. The lead sulphide was filtered off, and the filtrate was treated with dilute sulphuric acid, which separated a small quantity of oily substance. This melted at 26° and was recognised as anacardic acid. The filtrate from the grey precipitate was carefully evaporated at a low temperature, and left a yellowish coloured oily residue, which had a most irritating and acrid taste when applied in a most minute quantity to the tongue, and produced a redness and soreness when rubbed on the arm. It is evident, then, that the fruit contained a body very much allied to,

if not identical with, cardol, and that the constituents are very similar to those found in the marking nut.

The seeds when dry had a peculiar odour of *Ceratonia* pods. They contained gallic acid, 12·4 per cent. of tannic acid, 8·5 per cent. of fat, and 3·7 per cent. of mineral matter. A section of the the seeds touched with a drop of caustic soda turned the colour of the anastomosing veins to a bright blue and formed a pretty object under the microscope. The alcoholic solutions of both pericarp and seeds gave a greenish colour with caustic alkalies; no doubt the principle giving this colour was contaminated with other substances which afforded red tints with soda, for when separated from the tannin it gave a blue colour. Basiner in 1881 found that the oil from the pericarps of the marking nut tree gave a green colour with potash, and Dr. Lyon in his 'Medical Jurisprudence for India' relies upon this test in detecting the presence of the marking nut in toxicological investigations. As will be seen above Baisner's test for the marking nut would show the same result if applied to similar preparations of *Holigarna*.

It is interesting to notice that the properties of the Holigarnas are similar to those of two other trees of the same natural order, namely the marking nut (*Semecarpus Anacardium*, L.) and the cashew nut tree (*Anacardium occidentale*,) L.), and from recent investigations by Dr. Pfaff on *Rhus toxicodendron* and *Rhus venenata*, it is not at all improbable that cardol is present in other vegetable products of the Anacardiaceæ.

By David Hooper in Pharmaceutical Journal, June, 1895.